SCHOOL DOCUMENT NO. 8 — 1894.

REPORT

OF THE

DIRECTOR OF PHYSICAL TRAINING,

ADOPTED BY THE COMMITTEE ON HYGIENE AND PHYSICAL TRAINING, AS ITS REPORT.

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REPORT.

To the School Committee:

The present department of Physical Training owes its existence to the School Committee of 1889–90, which ordered, June 24, 1890: *that the Ling or Swedish system of educational gymnastics be introduced into all the public schools of this city.* The policy thus initiated was of necessity tentative, and still continues so. The wisdom of the vote referred to, and the success of the measures adopted for the purpose of carrying it into effect, cannot be fully and fairly estimated except in the light of the history of similar experiments made by the Boston School Committee in times past. Similarly no just and adequate judgment can be passed as to the importance and value of the results achieved by the Boston School Committee during the sixty years that have elapsed since it began experimenting with physical education, unless the most notable experiments of like nature elsewhere are taken into account. Furthermore, the value and success of any scheme for the advancement of any branch of physical training is conditioned upon: (1) the extent to which its promoters and managers give heed to the lessons of experience; and (2) the degree of fidelity with which they follow the plain teachings of proven science.

SCOPE OF FIRST REPORT.

Accordingly in my first report I endeavored to set forth and to characterize the principal events which have signalized the history of physical education in Christendom during

With the compliments of

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the nineteenth century; to describe in a general way the attempts that have been made in this country, — and more particularly in our own Commonwealth and city, — during the past seventy years, to make physical training a genuine and effective department of public and private education; and to give a connected account, in a somewhat detailed way, of the measures taken in relation to physical education by the Boston School Committee since 1833 (the date of its first enactment on the subject), so far as those measures could be determined from a study of the Committee's records and reports, and its rules and regulations. Attention was called to some of the fundamental teachings of modern science with regard to the nature and effects of systematic bodily exercise. The practical bearing of such teachings upon the problems we are endeavoring to solve was likewise adverted to, but not enlarged upon.

SCOPE OF PRESENT REPORT.

In the following pages, which constitute my second report, I desire to discuss somewhat more fully and particularly the principles of physical education in the light of physiological and psycho-physical science, in order that we may arrive at a clearer understanding of the close — nay, vital — relations which exist between physical and all other forms of education, and in order to establish a standard of measure which shall enable us to estimate the worth and weight of the results of our endeavors.

For the sake of presenting my material in what seems to me its proper consecutive order, I defer to the latter part of this report the account of my stewardship during the interval since December 31, 1891, the date of my last report, and those suggestions which have occurred to me as to the ways and means best calculated to secure the further and lasting efficiency and prosperity of this department.

BEGINNINGS OF PHYSICAL EDUCATION IN NEW ENGLAND.

The interest of New England educationists in the physical side of education had its flickering beginnings in the early twenties, and was due to the quickening influence of educational reform in Europe. During the decade ending in 1830, this interest, which was manifested chiefly by enterprising innovators in the domain of private secondary and superior education, exhausted itself in a few crude and practically fruitless experiments. Equally crude and fruitless were the attempts to make manual labor and training a forceful factor in liberal education. It was not until near the close of the decade 1850–1860 that any extensive revival of interest in the advancement of physical education declared itself.

LEWIS PERIOD.

In the period 1860–1866, which has been termed the Lewis or Light Gymnastic period, the teachers and managers of public schools, especially in New England, awoke, in a measure, to the clearly growing need of more effectual measures for promoting the health and vigor of the school population by means of gymnastic exercises. This awakening betokened a decided advance in public sentiment, since the movement of 1820–1830 had scarcely affected the public schools. This awakening gave rise to widespread enthusiasm and to numerous attempts to organize school gymnastics. Few, if any, of these attempts were intelligently planned and adequately organized; and most of them, through lack of efficient leadership or by reason of timid and grudging support, soon lapsed into insignificance and desuetude. The achievements of this period would have been greater, doubtless, but for the engrossing interest which the War of Secession exerted upon the educational as well as the popular mind. As it was, school gymnastics became secondary to military drill and elocution.

ATHLETIC REVIVAL AND ERA OF GYMNASIUM-BUILDING.

After the war closed, athletic sports received a great impetus, and it is chiefly due to their rapid expansion and robust development that the era of gymnasium-building, which opened with the completion of the Hemenway Gymnasium at Harvard University in 1880, owes its rise. It is chiefly since 1880, or rather since 1885, the year in which the cities of Kansas City and Chicago inaugurated their present systems of school gymnastics, that municipal authorities have shown renewed and increased activity in the discussion of measures looking to the better organization and management of physical training. While it is indisputable that this activity of mind has been stimulated to a measurable degree by the spread of professional and college athletics, certain other influences seem to me to have been far more powerful in determining the force and direction of the present movement for the advancement of physical education.

THE SPREAD OF SCHOOL GYMNASTICS IN CITIES, AND ITS CAUSES.

Prominent among the secondary agencies that have contributed to the introduction, in several of the leading cities of the country, of methods of gymnastic instruction that have stood the test of trial in Europe stand the achievements of the promoters and advocates of the German and Swedish systems of school-gymnastics. They deserve grateful mention and wider recognition than has been accorded to them hitherto, but they do not constitute an original and primary force. They derive their significance, as do the fragmentary and ill-compacted "systems" of their vociferous rivals, from a deeper source and a wider movement that bears them all on its ever-swelling tide. It can hardly be disputed that the *primum movens* of the restless and flooding agitation for hygienic reform in education — one phase

of which we see reflected in the physical education movement — is to be found in the widespread, half unconscious but deeply seated and unappeasable yearning of the people for efficient means wherewith to counteract the destructive influences which threaten the health and vigor of the children fated to be born and bred in the great cities of the land. Were the people's knowledge even approximately commensurate with their need and desire, the abatement of many an unsanitary and baleful nuisance in the field of public education would be in the past instead of the future tense.

THE INCREASE OF GREAT CITIES.

The growth of great cities is one of the most striking and momentous phenomena of the present century. The increase of urban over rural population has been particularly marked in Great Britain and the United States. In 1811 only 24 per cent. of the population of England and Wales lived in towns and cities of more than 10,000 inhabitants. In 1861 44 per cent. of the population was found in such towns, in 1881 56 per cent., and in 1891 62 per cent. In 1811 there was no city in England but London that had over 100,000 inhabitants. In 1861 the number of such towns had risen to 12, and in 1891 to 24. However, the "urbanization" of England seems to have been less rapid in the period 1881–1891 than in several of the earlier decades of the century.

In the United States, where the population of towns and cities of less than 8,000 inhabitants is termed rural by the census authorities, the urban population has increased from one-thirtieth, in 1790, to nearly one-third of the whole population in 1890, while the number of cities with 8,000 inhabitants has increased from 6 to 443 during that period. Of these 443 cities, 28 had upwards of 100,000 inhabitants.

MASSACHUSETTS THE COMMONWEALTH OF CITIES.

In the United States, Massachusetts is *par excellence* the Commonwealth of Cities. According to the terminology of the United States Census Bureau, the urban population of Massachusetts in 1890 constituted 69.90 per cent. of the population of the State — there being 47 towns and cities with a population of 8,000 or upwards. In 1880 the number of such towns and cities was 33. Since 1890 the number of municipalities having a city charter and a population of at least 12,000 has risen from 28 to 31. According to the Eleventh Census, as has been pointed out recently by a writer in the "New York Evening Post," there are: 9 States in the Union having no city with 20,000 inhabitants; 9 States having 1 such city; 4 States with 2 and 1 State with 3 such cities; while Massachusetts has 20 cities with a population of at least 20,000. In other words, "Virginia and half of the States of the Union combined show no more cities of over 20,000 inhabitants than are to be found in Massachusetts." "It is further worth notice," says the same writer, "that the 20 cities just mentioned in Massachusetts are a larger number than can be discovered in any other State, though 5 States have a larger census. While the population of Massachusetts is three-fourths of a million less than half of that of New York, her cities of the 20,000 class are more by 2; those in Pennsylvania are only 16; those in Ohio, 10; in Illinois, 7; in Missouri, 4."

It is estimated that in England just before the visitation of the Black Death in 1348–49, eleven out of every twelve Englishmen, or 91 per cent., lived in the country, and it has been prophesied that the time is at hand when the urban districts will contain as large a proportion of the English people as the rural districts contained in the time of King Edward II. In Massachusetts, in the early years of this century, the proportion of rural to urban population did not differ widely

from that which obtained in England five centuries and a half ago, since we find that in 1820 — when there were only two towns in the State, viz., Boston and Salem, large enough to become cities under our present statute — 89 per cent. of the population was in towns of less than 7,000 inhabitants. Should the urbanization of the State proceed at its present rate, eleven-twelfths of our population will be city-people before ten years have passed. Surely for us there is food for thought in the declaration that "the further progress of civilization is to depend mainly upon the influences by which men's minds and characters will be affected by living in large towns."

GENERAL EFFECTS OF URBANIZATION AND OF SEDENTARY OCCUPATIONS.

The well-nigh universal belief that the influences and concomitants of city life are prejudicial, on the whole, to continuous vigorous health seems to be well founded. The death-rate of urban districts, the world over, is almost invariably higher than in country-districts. This is especially the case as regards the mortality of infants and children. But for the influx of country-born men, great cities could hardly maintain either their size or their importance. More than forty years since, Sir Anthony Carlisle, an eminent and experienced medical man in London, declared that "no persons town-bred in both the male and female lines ever extend their children to the fourth generation." "The city of Paris," says a recent writer, "with its environs, boasts nearly one-twelfth of the total population of France, yet it does not escape the charge, which lies against so many other great cities, of being a huge maw into which the best of the national life is sucked. Only in the slightest degree is it the parent of the energy and distinction which it displays on so great a scale. In the political field, scarcely one of the distinguished men of the time is Paris-born. The President of

the Republic is not, nor is the President of the Senate or of the Chamber; not one of the ten Cabinet Ministers, neither of the Chief Justices nor of the Attorney-Generals of the higher courts, reckons Paris as his birthplace, nor does the Governor of the Bank of France. Somewhat similar results are obtained by scanning the lists of distinguished scholars, artists, journalists, soldiers. From the provinces have come a disproportionate majority of the men whose success in life makes Paris famous. Such facts are more striking in the case of the French capital, whose preponderance over the rest of the country has been so long established, than they would be in a newer country, where the headlong rush to the cities is a comparatively new thing."

Doubtless city death-rates are directly affected by the fouling of air and water and soil, and to the increased propagation of infectious diseases; but as Dr. Ogle, of London, has pointed out, these "direct consequences of close aggregation are probably as nothing in comparison with its indirect consequences or concomitants. The more crowded a community, the greater, generally speaking, is the amount of filth, of crime, of drunkenness, and of other excesses, the more keen is the competition, and the more feverish and exhausting the conditions of life; moreover, and perhaps more than all, it is in these crowded communities that almost all the most dangerous and unhealthy industries are carried on."

It is a significant fact that the death-rate of Boston should be highest in its most crowded quarters. For instance, in 1890 the death-rate for Wards 8, 9, and 16 taken together, with an average of 166 persons to the acre, was 29.40 per 1,000 living, while the death-rate for Wards 23, 24, and 25, having four persons to the acre on the average, the death-rate was only 18.61, while the general death-rate for the city, with an average of twenty persons to the acre, was 24.8, according to the United States Census.

Our modern factory system, besides stimulating the un-

due concentration of the operative and dependent laboring classes within narrow areas under unsanitary conditions, tends directly to promote a minute subdivision of labor, and in consequence an inordinate multiplication of crafts and occupations whose requirements may be met, for a time at least, by fractional not to say mutilated powers of mind and body. In this way what are termed "hands" in the labor market are produced, and the more rugged and massive muscular and mental powers, whose due exercise is essential to the development of whole, that is to say, of hale or healthy, men and women are suffered to dwindle and decay.

"It is certaine," says Lord Bacon in one of his essays, "that *Sedentary* and *Within-doore Arts*, and delicate Manufactures (that require rather the Finger than the Arme) have in their Nature, a Contrariety, to a Military disposition." While we may or may not agree with him in saying that "the Principal Point of *Greatnesse* in any *State* is to have a Race of Military Men," it cannot be denied that there is much hygienic wisdom embodied in his further proposal "to leave those Arts chiefly to Strangers, and to containe the principall Bulke of the vulgar Natives within those three kinds; *Tillers* of the Ground; *Free Servants;* & *Handy-Crafts-Men*, of Strong and Manly Arts, as Smiths, Masons, Carpenters, &c.; Not reckoning Professed Souldiers."

Did space permit, it could readily be shown that urbanization tends to cripple and shorten the lives and to weaken the offspring of men and women devoted to certain classes of occupations, but what concerns us most, in this connection, is a closer consideration of some of the means whereby we may in a measure protect the children in our public schools from the dangers that threaten them just because they are city-children; and the statement must here suffice that to the multiplication of "*Sedentary* and *Within-doore Arts*, and delicate Manufactures," must be ascribed a by no means inconsiderable portion of the increased mortality from certain

of the most deadly diseases of modern city-life, such as diseases of the respiratory and circulatory organs, and diseases of the nervous system.

PREPONDERANCE OF CITY CHILDREN IN MASSACHUSETTS SCHOOLS.

The following table, which I have compiled from data contained in the Report of the Massachusetts Board of Education for 1891–92, is introduced to show how far public-school education has become a city matter in our State. The main conclusion to be derived from it is, that the control of public-school affairs in Massachusetts is already in the hands of city school boards.

TABLE I.

SHOWING PROPORTION OF PUBLIC–SCHOOL POPULATION AND EXPENDITURES IN TOWNS AND CITIES OF 10,000 INHABITANTS AND OVER, AND IN THE CITY OF BOSTON, 1891–92.

	In the State at Large.	In 37 Towns and Cities of 10,000 and over.	Per Cent.	In Boston.	Per Cent.
Population in 1890	2,238,943	1,475,086	65.88	448,477	20.00
Number of Public Schools . .	7,336	3,603	49.11	690	9.40
Teachers in Public Schools .	10,965	5,435	49.55	1,420	12.95
Pupils in Public Schools . . .	383,217	242,063	63.16	68,963	17.92
Average Number of Pupils to a Teacher	34.9	[1] 44.5		[2] 41.5	
Amount Expended for Public Schools from Taxes	$9,058,938.26	$6,403,720.82	70.68	$2,028,102.39	22.87

[1] Corresponding figures for country districts, 25.5.

[2] Ditto for Boston Primary and Grammar Schools, 50., i.e., 52. Primary Schools, 48. Grammar Schools.

STANDING OF EDUCATION AMONG MASSACHUSETTS INDUSTRIES.

The economic worth of a healthy and vigorous race of school children is a calculable quantity. I therefore venture to class education among the leading industries of Massachusetts, and to present some comparative tables in order to emphasize some of the economic relations existing between this and other industries, though, in a sense, it is hardly fair, perhaps, to compare a robust unprotected industry with those that have so long led the protected "infant class," economically speaking.

TABLE II.

SHOWING ECONOMIC STANDING OF PUBLIC EDUCATION IN MASSACHUSETTS IN 1885, COMPARED WITH THAT OF LEADING INDUSTRIES.

Industries.	Number of Establishments.	Number of Persons employed.	Capital invested.	Wages paid.	Value of Stock and Material used.	Value of Product.
Cotton goods	165	60,132	$118,947,040	$16,915,633	$36,625,530	$61,425,097
Boots and shoes	2,366	64,858	34,313,421	26,916,608	70,178,677	114,729,533
Metals and metallic goods . . .	2,782	24,233	33,194,607	11,303,973	19,240,584	41,332,005
Woollen goods	189	18,970	29,995,668	5,688,981	19,422,953	31,748,278
Machines and machinery . . .	622	14,644	24,743,677	7,249,470	7,539,470	20,365,970
Leather	699	9,228	12,258,831	4,313,674	19,713,559	28,008,851
All industries	23,431	379,328	500,591,377	147,415,316	389,757,458	674,634,269
Public education	6,453	9,652	26,975,450	5,003,700	[1] 171,313,330	[2] 19,324,008

[1] Value of all pupils, see below.

[2] Value of graduates, see above.

The above table affords a comparative view of the salient economic facts concerning public education, the leading industries, and all industries of Massachusetts in 1885, the year in which the last State Census was taken. I am under special obligations to the Chief of the Bureau of the Statistics of Labor, Horace G. Wadlin, Esq., who has kindly furnished the table from the official records of his bureau. Under the head of "public education" I have added certain items so as to include the State school fund, the salaries paid to the officers of the State Board of Education, and the salaries of the principals and assistants in the State normal schools. The sum paid school committees for school supervision in 1885 is also included under the head of "wages paid," though the number of persons employed includes only superintendents of schools and teachers. I have computed the value of "stock and material used" and "value of product," under the head of "public education," according to a method which is explained below. Properly speaking, the raw material used in the public education-industry consists of pupils entering for the first time each grade of school during the year in question, but it is impossible to determine their number from existing educational statistics. The sum given, viz., $171,313,330, represents the estimated value of all the pupils found in the public and State normal schools in 1885, and therefore is not strictly comparable with the other figures in the same column, though it does represent the present value, for that year, of the public-school population as wage-earning machines in the process of manufacture. The value of product, viz., $19,324,008, is the combined estimated value of the graduates, for the year, from the normal, high, and grammar schools of the State, and is based, as regards the last two classes of graduates, upon the actual number graduated from the Boston high and grammar schools in 1885.

The above table is obviously incomplete, as regards the

extent of the education-industry of Massachusetts, since it relates to but one department of that industry, viz., public education. Some notion of the relative importance of the various branches of education pursued in this State may be gained from the following table. It was necessary to choose the year 1889–90, since the necessary data for 1885 were not to be had.

TABLE III.

SHOWING APPROXIMATE EXTENT OF EDUCATION IN MASSACHUSETTS IN 1889–90.

	Number of Institutions.	Number of Instructors.	Number of Students or Pupils.	Capital invested in Buildings, Grounds, and Funds.	Wages paid.	Number of Graduates.	Estimated Value of Graduates.
1. Colleges and Universities	16	773	6,365	$19,704,347	.....	626	$4,462,128
2. Technological Schools	5	217	1,274	2,872,922	.....	.....	.....
3. Professional Schools	10	226	1,651	.....	.....	246	2,048,196
4. Academies	72	367	7,209	5,973,873	.....	643	1,889,710
5. Board of Education	1	7	.....	2,729,396	$17,500	.....	.....
6. Public Normal Schools	11	35	1,492	602,100	74,869	411	1,953,072
7. Public Schools	7,147	10,415	371,492	23,844,069	5,324,000	17,244	16,871,976
8. Private Schools	399	.....	43,355	.....	.....	.....	.....
9. Schools for Defectives	6	76	809	788,693	.....	.....	.....
10. Nurse Training Schools	5	18	306	.....	.....	96	684,288
Education as a whole	7,672	12,134	433,953	$56,515,400	$5,416,369	19,266	$27,909,370
All Public Education. — Total of Nos. 5, 6, 7	7,159	10,467	416,349	$27,175,565	$5,416,369	17,655	$18,825,048
Private Education	513	1,667	17,604	$29,339,835	.....	1,611	$9,084,322

The above table is only approximative, as the Report of the United States Bureau of Education and the Report of the Massachusetts Board of Education, from which I have compiled it, do not contain sufficient data wherewith to make it complete. For instance, the number of graduates from the public schools is computed on the assumption that Boston (the number of whose graduates from the grammar schools is found in the Report of the Superintendent of Schools) furnishes one-sixth of the grammar-school "output" of the State, since it contains more than one-sixth of the school population of the State. It is impossible even to guess at the amount paid in wages to the instructors outside of the field of public education. Furthermore, there are no sufficiently comprehensive statistics available as to the number of pupils in schools of art, music, "expression," elocution, gymnastics, Christian science *et id omne genus;* or as to the proportion of the student class in Massachusetts who become temporary residents of the State in order to avail themselves of its educational facilities. Still the totals in Table III. are large enough to be noteworthy.

THE MONEY VALUE OF OUR SCHOOL POPULATION.

I am perfectly well aware that in the present crude and undeveloped state of the educational and vital statistics of Massachusetts, no full and exact estimate can be made of the money value either of the raw material undergoing transformation, of the raw material wasted, or of the finished product turned out by our education-mills; but a suggestive and fairly satisfactory estimate of the value of our school-population as a collection of potential wage-earning organisms or machines may be reached if we adopt certain conclusions of the late Dr. Farr, of London, than whom neither Great Britain nor America has produced a more trustworthy and masterly student of vital statistics. According to Dr. Farr's table entitled the "Money Value of a Man"

(see his "Vital Statistics," London, 1885, p. 536) the "present value" of the future wages of an English agricultural laborer, after deducting the cost of maintenance, is £5 at birth; £56 at 5 years; £117 at 10 years, and so on up to 70 years; the maximum, £246, being reached at the age of twenty-five. By using a table based on the above figures showing the value at each age from 5–20 years, the total value of the 58,838 children in the schools of Boston in 1889–90 is found to amount to $29,830,222, allowance being made for the admixture of females, and the slightly greater wage-earning power of certain classes of Massachusetts operatives, as compared with English. Assuming that the valuation of the public-school children in the State was six times greater, since the Boston schools contained one-sixth of all Massachusetts public-school children in 1890, and adding $886,248 to the product as representing the money value of the pupils in public normal schools, we find $179,867,580 to be the calculated value of the "stock and material" placed at the disposal of the "persons employed" in the public-school industry of the State in 1890. The "value of product" I have set at $20,881,005, that being the sum of the estimated values of the graduates of the grammar, high, and normal schools of Massachusetts taken together in 1890. It is manifest that college graduates and grammar-school graduates have not the same value as potential wage-earners. Dr. Farr's tables give the highly paid agricultural laborer's earnings, for a series of years, as about one-fourteenth of the earnings of a professional man of moderate income. In estimating the comparative value of the output of elementary, secondary, and superior educational institutions, I have adopted the following rough scale:

1 grammar-school graduate = 1 mill hand = $594.00
1 high-school graduate = 5 mill hands = 2,970.00
1 normal-school graduate = 8 mill hands = 4,752.00
1 college graduate = 12 mill hands = 7,128.00
1 professional-school grad., = 14 mill hands = 8,316.00

If the amount paid in salaries to teachers, superintendents, etc., were capitalized at four per cent., the amount of "capital invested" given in Table III. would be increased by more than one hundred millions of dollars. A very considerable sum arising from the money paid for tuition, living expenses, etc., by those of the student class who come from other States, helps to swell the wealth of Massachusetts year by year, and should be credited to the education industry, if it were our purpose to attempt to make a complete study of the economic value of that industry.

By far the greater part, say 90 per cent., of the population of Massachusetts between the ages of 5 and 15 are engaged in the occupation of attending school. For instance in 1885, the year of the last State Census, of the 358,393 persons in Massachusetts ranging in age between the above-mentioned limits, it would appear that 312,751 were so engaged. That is to say, the number of persons of the age-class in question, devoting their time and energy to the distinctively "Sedentary and Within-doore" occupation of schooling, outnumbered, by more than 80,000, *thrice* the total number of persons of all ages engaged in agricultural pursuits in 1885; and fell short by only 67,000 of the number of persons engaged in all the manufacturing industries of the State in the same year.

INFLUENCE OF SCHOOL LIFE ON DEATH-RATES.

How far "schooling" as an occupation is beneficial or prejudicial to public health in the United States is largely an open question, as nowhere in the country, so far as I am aware, have school authorities or boards of health taken effectual measures to settle it. It is scarcely too much to say that it would be easier, under present conditions, to estimate the losses entailed by hog cholera and the cattle plague throughout the Union than to determine the number of children who succumb annually to school diseases in

any State. Except by indirect methods, it is not possible to compute, even in Boston, the crude death-rate of school children, as such, from any official reports; while comprehensive and accurate statistics showing the number of school children who are incapacitated annually by sickness, for a longer or shorter period, are utterly lacking. Various reasons might be adduced to account for this strange neglect of the scientific study of school-life and its effects. One, however, will suffice here. It is this: nobody, broadly speaking, takes the trouble to compile the morbidity or mortality statistics of school children and youth, for either academic or practical purposes, because nobody is or would be paid for so doing.

Convincing statements either pro or con based on wide and accurate observation of facts regarding the influence of school-life upon the death-rate of children are not numerous. I know of none so well worth quoting as the following from the Report for 1882 of the Registrar-General of England: "The death-rate of children (5–15) in 1861–70[1] (in England and Wales) was 6.3 per 1,000. It fell in 1871–80 to 5.1 per 1,000; a decline of 19.05 per cent. The main part of this fall was due to diminished mortality from the chief zymotic diseases. These diseases caused a mortality of 2.9 per 1,000 in the first decennial period, but only 2.1 per 1,000 in the second. In the first period (1861–70) the death-rate from all causes other than zymotic was 3.4 per 1,000; in the second it was only 3.0.

"But inasmuch as school work if it be injurious to health would probably be so by affecting the brain and generally the nervous system, it would be well to split up these death-rates from causes other than zymotic into death-rates from diseases of the nervous system and death-rates from other causes. When this is done, we find that the entire fall was due to diminished mortality from other causes.

[1] It should be remembered that England had no Board Schools till 1870.

The rate from these fell from 2.9 to 2.5 per 1,000, whereas the death-rate from nervous affections remained unaffected. Indeed, if a second place of decimals were taken, it would appear that nervous diseases had slightly, very slightly, increased.

"*It would appear, therefore, that while the mortality of children from all causes and from zymotic causes has considerably diminished, their mortality from diseases of the nervous system has exceptionally remained stationary. The general improvement has not affected this class of diseases.*"

The statistics published by our State government with regard to deaths from special causes, at different age-periods, are so meagre and incomplete as to preclude a strict comparison between the death-rates of English children, given above, and the corresponding death-rates of Massachusetts children. Still, such evidence as we have favors the view that the proportion of deaths due to diseases of the nervous system to deaths from all causes, *at all ages, and during the age-period* 5–15, increased in Massachusetts between 1880 and 1890.

ESTIMATED LOSSES DUE TO DEATHS OF MASSACHUSETTS SCHOOL-CHILDREN.

According to the report of the State Board of Education rather more than 89 per cent. of the children (5–15) living in Massachusetts in 1885 were found in the public schools. It is fair, therefore, to assume that at least 89 per cent. of the children dying between 5–15 years of age were public-school children. The average net value of the Massachusetts child (5–15) may be set at $478.41. In 1885 the deaths in the State among this class of children numbered 2,025, representing a total loss of $968,780. Reckoning the loss due to deaths among school-children at 89 per cent. of the above sum, we have $862,215. The deaths of children between 5–15 in Boston numbered 500 in 1885, involving a loss of $239,205,

of which sum $181,795 represents the loss accruing from deaths of public-school children between 5–15; which loss equals 17.5 per cent. of the total money-value of all the graduates of the Boston grammar schools in that year. If the cash expended by the city for the schooling of the public-school children who died in 1885 be added to the sum last mentioned, we have a total loss of more than $193,000 for the year. There is abundant and convincing evidence that Boston death-rates are so high as to entail an unnecessary annual loss of lives and wealth. The subjoined Table IV. is adduced in support of this statement:

COMPARISON OF BOSTON, BERLIN, AND LONDON DEATH-RATES.

TABLE IV.

SHOWING THE RELATION BETWEEN CERTAIN DEATH-RATES OF BERLIN (PRUSSIA), BOSTON, AND LONDON (ENGLAND).

	General Death-rate, *i.e.*, Average Annual Mortality per 1,000 Inhabitants of all Ages, 1881–90.	Special Death-rates, 1885–90, *i.e.*, Average Annual Mortality per 1,000 living at each Age-Period.			
		Persons under 5 Years.	Persons 5–10.	Persons 10–15.	Persons 5–15.
	1.	2.	3.	4.	5.
Berlin . . .	24.5	110.0	7.1	2.6	4.8
Boston . .	23.3	88.2	(8.2) [1]	(4.2) [2]	6.6
London . .	19.1	61.2	5.1	2.6	3.9

The primary purpose of this table is to discover whether Boston school-children die in greater numbers than is necessary and irremediable in comparison with London and Berlin

[1] Average rate for Massachusetts in censuses for the years 1865–1885, as the Boston rate cannot be computed from published data. For the years 1875, 1885, and 1890 taken together, Boston death-rates were as follows: 5–10 years, 8.8; 10–15 years, 4.5; 5–15 years, 6.9 per 1,000 living.

children; and incidentally to compare the mortality rates of the three cities: (1) at the age-period in which deaths are most frequent, *i.e.*, from birth to 5 years of age; and (2) at the age-period in which deaths are least frequent among civilized men, *i.e.*, from 10 to 15. The general death-rate is given too, though it is of less importance in this connection. While a comparative table showing the relative rank of American cities as regards the death-rates selected would be instructive, and almost certainly more encouraging, I have chosen, or rather have been obliged to choose, to compile the death-rates of London and Berlin, since our American cities do not publish sufficiently full and detailed vital statistics to enable me to prepare such a table as that given above. The mortality rates of Boston children between 5 and 10, and 10 and 15 years, respectively, are in all probability considerably higher than the rates given in columns 3 and 4, which are rates for Massachusetts — corresponding rates for Boston being very difficult, if not impossible, to compute from published data.

Analysis of Table IV. show that, as regards each of the five death-rates chosen for comparison, Boston has a higher mortality than London; and that, excepting the general death-rate and the death-rate for children under 5 years of age, its mortality rates are also higher than the corresponding rates of Berlin. Boston's birth-rate is much lower than that of Berlin, it should be remembered. That Boston should lose, in round numbers, 3 children to the thousand of school age more than London, and 2 to the thousand more than Berlin, every year, is a significant and by no means consolatory fact, especially as the total population of London is more than nine times that of Boston, and more than three times that of Berlin, while London's population between the ages of 5–15 for the years 1885–90 was over eleven and Berlin's over three times greater than Boston's population from 5 to 15. Moreover, Boston is less densely populated by far

than either London or Berlin. Another fact may be instanced as showing that Boston's death-rate is abnormally high. It is this: the general death-rate for the whole of Boston, and the general death-rate of the central districts of London, *which include its East End slums*, were identically the same in 1892; viz., 23.9 per 1,000 inhabitants.

BOSTON CHILDREN OF SCHOOL-AGE DIE FASTER THAN LONDON AND BERLIN CHILDREN.

According to the returns of the School Census of Boston, the average annual population of the city between 5 and 15, for the years 1885–90, was 71,000 in round numbers; and according to the Registration Reports the average annual number of deaths of Boston children (5–15) was 471. During 1885–90, according to the School Census returns, the number of children 5–15 in the public schools of Boston was 76.8 per cent., on the average, of the whole number of such children in the city. Had Boston's death-rate been as low as that of Berlin, viz., 4.8 per 1,000 children of 5–15, only 341 deaths of this class would have been registered annually, a saving of 130 lives; while a death-rate of 3.9, as in London, would have called for the registration of only 277 such deaths, an average annual saving of 194 lives during 1885–90. In other words, Boston threw away 130 children of school age, on the average, during each of the six years in question, judged by the Berlin standard; while according to the London standard the average annual, needless loss amounted to 194 children's lives, of which number 77 per cent., or 149, belonged to public-school children. During the period in question Boston spent $27.53 annually, on the average, for every child belonging to its public schools (exclusive of expenditures on new buildings, etc.), which sum multiplied by 149 gives us $4,101.97 as the amount of taxpayers' cash annually thrown away on children who die because they are Bostonians rather than Londoners, while the total loss, com-

puting the money value of 149 school-children at $478.41 each, would be $75,385, or about 5 per cent. of the average net annual running expenses of the Boston schools in 1885–90.

It is possible, of course, to attribute the greater healthfulness of London, as compared with Boston, to the relative insalubrity of our New England climate; though one who is not disposed to blink the facts may doubt the existence of such insalubrity, aside from any unwillingness to disavow the valiant boast of our ancestors anent the superiority of New England air to Old England's ale. Why, may we ask, should the harder-worked school-children of Berlin, living in a city thrice as large as Boston and at least thrice as densely populated, and subjected to climatic influences usually held to be worse, hold out so much better against the ravages of disease and death, unless it be that municipal and school sanitation are better devised and more efficiently carried out on the banks of the Spree than on the banks of the Charles?

HIGH LOCAL DEATH-RATE OF BOSTON.

Let us consider the suggested superiority of the London climate for a little. It is fair to assume that the climate of London is the climate of England, and that the climate of Boston is the climate of Massachusetts, to all intents and purposes. Admitting for the sake of argument that the lower general death-rate of England in comparison with that of Massachusetts is due to climate, the excess of deaths in Massachusetts amounts to less than 1 per thousand; since the death-rate of England (18.71 per 1,000 inhabitants for the period 1885–90) is only 0.75 less than that of Massachusetts, which was 19.46 during the same period. London's death-rate, 18.98 per thousand (1885–90), exceeds the death-rate of England by only 0.27, which would appear to represent the total effect of the various death-producing influences due to its being a city. Boston's death-rate (1885–90) was 24.01, an excess of 4.55 per thousand over the

death-rate of the State. This excess, 4.55 per thousand, represents the effect of local — *i.e.*, city — influences. Subtracting 0.75 as due to the superiority of English over Massachusetts climate, and we have 3.80 per thousand as the death-rate from local or distinctively Boston influences, so that after making allowance for climatic influences, "*Boston's local death-rate*" *appears to be fourteen times as great as London's local death-rate!* Surely there is ground for the suspicion that municipal sanitation is less effectual in Boston than in London, even if we give full weight to the suggestion that immigration adds much more to the mortality of Boston than to that of London.

SANITATION LESS EFFICIENT IN BOSTON THAN IN LONDON.

An approximate test of the efficiency of municipal sanitation is found in the relative mortality due to infectious diseases. If Boston and London were equally healthful cities, the deaths in them from infectious diseases might be expected to bear approximately the same ratio to each other as the ratio of their respective populations. But the total number of deaths in London, in the decade 1881–90, from diphtheria, scarlet fever, typhoid fever, and measles was less than five times as great as the total deaths in Boston from the same diseases during that period, though London's total population is nearly nine and one-half times greater than that of Boston! Verily, the wages of sanitary shortcomings is death.

So much for the more general and salient features of the situation. It would be presumptuous and idle, in lieu of positive evidence derived from a searching and thoroughgoing investigation into the deeper and more complicated phases of the question of public and school hygiene, to attempt to show what proportion of the losses annually sustained by this city from preventable diseases and death

should be charged to public apathy and ignorance, to private neglect and transgression of municipal ordinances, and to inadequate and ineffectual measures of one or another branch of the city government. But it is tolerably certain that there is abundant need and ample scope for more comprehensive and vigorous action, than is taken at present, on the part of every board and bureau that is concerned, even remotely, in promoting either the health of the public as a whole, or in guarding the sanitary interests of a well-defined section of the population, such as is constituted by our school-children.

REDUCTION OF DEATH-RATE IN THE UNITED STATES ARMY BY HYGIENIC MEASURES.

As an example of what can be effected by a well devised and efficiently managed system of hygiene, adapted to meet the peculiar needs of a particular class, the good health which characterizes the rank and file as well as the officers of the United States Army may be instanced. Due allowance being made for the fact that only men of sound physique are accepted as recruits, the relatively high health of the common soldier must be attributed, in no small measure, to the scrupulous enforcement by competent and responsible experts of an adequate and intelligent system of professional and personal hygiene. That the health of the army is unusually high is evident when we compare its general death-rate with the general death-rate of the country at large for the age-period 20–60 years — since the number of men over sixty in the army is so small that it may be left out of account. In 1880, according to data found in the Tenth Census of the United States, the death-rate of men between 20 and 60 years of age was 9.36 per thousand, that of the Army of the United States for the decade 1881–90 was considerably less, viz., 8.57 per thousand, while for the three years 1890–92 it was 7.72, and in 1892 only 6.11 per

thousand, *or* 0.53 *per thousand less than the death-rate during* 1885–90 *of Boston children of* 5–15, *which, be it remembered, is the most healthful decade in their lives.*

INSTRUCTION IN PHYSIOLOGY IS INEFFECTUAL FOR SECURING HEALTH OF SCHOOL-CHILDREN.

It is now more than forty years since the Massachusetts Legislature enacted a law authorizing school committees throughout the Commonwealth "to make physiology and hygiene a compulsory study in all public schools," and requiring all public-school teachers to be "examined in their knowledge of the elementary principles of physiology and hygiene and their ability to give instruction in the same." Is it probable that military-hygiene could have been brought to its present state of efficiency if the War Department had placed its main reliance for securing the health of the army on an Act of Congress passed in 1850, requiring sergeants and corporals to be examined as to their ability to instruct the rank and file in the "elementary principles of physiology and hygiene," and had forborne to give the Medical Staff any jurisdiction outside of hospital precincts? Is not the present low estate of school-hygiene, which has practically no standing among the arts and sciences in the United States, due, at least in some degree, to the neglect or avoidance by State and city boards of education of the very policy which makes military-hygiene so conspicuously successful?

Judged by its fruits, the Massachusetts policy of promoting the health of school-children by the "dissemination of useful information" as to the nature and needs of the human body has not proved a success. Neither the subject-matter nor the methods of teaching employed in the instruction given in our schools in physiology and hygiene has kept pace with the striking development which those sciences have undergone since 1850. The text-books furnished our teachers in those subjects, for the most part, are the produc-

tions of mere compilers and book-makers, who are in no sense worthy to be termed physiologists or hygienists. So long as reliance is placed upon such feeble and futile measures, and the generality of State and local boards of education are content to ignore or to misapply the principles of school-hygiene, it seems vain to hope for the general adoption of a policy adequate to protect the rising generation, in so far as it can be protected, against the deteriorating influences of school and city life. It is clearly manifest that the teaching class, as at present trained and constituted, is unequal to devising and enforcing a practicable and effectual system of school sanitation and hygiene. Whither shall we look for a Moses to lead the children of Massachusetts into the promised land of health and vigor, out of the arid wilderness of text-book lessons which they entered under the well-meant guidance of the State Board of Education, and in which they have been wandering for more than forty years? May it not come to pass that the continuance of the present *laissez faire* policy of school-boards as a class will provoke the boards of health to claim jurisdiction in regard to the prevention of school-diseases, even as they have taken over the control of school-children suffering from contagious and infectious disease?

It is too soon, perhaps, to say positively and precisely how far the denizens of our cities have degenerated or are degenerating in physique, since the country-districts still furnish the cities with a large contingent of sturdy and ambitious youth year by year. There can be no question, however, that vigorous efforts to improve the stamina of the school children of Boston would result in a very considerable saving of useful lives, and in enhancing the wealth and happiness of our people. It is within our power to forestall by preventive measures some of the evil effects of overcrowding, and of the growing addiction of the masses to sedentary pursuits, before the country-districts become depleted of their

better breeds of men. In this, as in other fields, preventive measures are more hopeful and less costly than are means of cure.

PLACE OF MUSCULAR EXERCISE AMONG HYGIENIC MEASURES.

Among the agencies which are most effectual for promoting and conserving the health of growing children, muscular exercise may be fairly placed next to pure air, sunlight, and a sufficiency of nutritious food. Popular belief and expert opinion are substantially at one in holding that exercise is necessary for children and "does a man good." But when it comes to the adoption of ways and means for securing appropriate and adequate facilities for the development and exercise of the muscular powers of school-children, one finds a bewildering variety of opinions and diversity of procedures. In the practical management of physical training, educational authorities throughout the United States have shown a marked tendency to follow rules of thumb rather than the teachings of science and experience. Yet those teachings are sufficiently plain and positive to warrant our discarding mere rules of thumb in this as in other branches of education.

THE HUMAN BODY AS A MACHINE, AND ITS WORK.

Modern physiology teaches us that the human body is a living mechanism "whose proper working," to borrow the words of Huxley "we term health; its disturbance disease; its stoppage death." In general terms, the main work of the body consists in transforming potential energy into active energy, or the energy of motion. The body's fund of potential energy is derived from the food-stuffs contained in the blood. The potential energy thus furnished is changed into active energy through the chemical processes which take place in the cells of the living tissues. Inasmuch as the

body is a self-building, self-repairing machine, it must continually renew its substance and replenish its capitalized or stored-up energy; hence a large part of its active energy is expended in the form of heat, chemical action, and internal mechanical work for purposes of general maintenance and repair. In this respect the human body is like all other animal machines. Man in contradistinction from the brutes — thanks to his more complicated structure and more highly specialized functions — has a relatively larger "live capital" of free energy that can be turned into special forms of mechanical work. In comparison with savages and barbarians, civilized men have a larger fund of such capital at command, together with greater aptitude for expending it wisely and economically; while among civilized men, the educated man, by reason of his superior training, is able to do more and harder and better work than the ignorant man. From our present standpoint, the main end of education appears to be to develop as fully as possible the power of making the most of the fund of energy which is available, in the individual organism, after the maintenance and repair of that organism have been provided for.

INTERRELATION OF MENTAL, MORAL, AND PHYSICAL TRAINING.

Moral, mental, and physical training, each and all, aim at developing the faculty or power of action — of acting in accordance with a rule of right and wrong, of acting intelligently, so that action and the ends of action shall be adapted to each other; of acting easily or with the greatest economy of force; *i.e.*, so that energy shall not be wasted in puposeless, irrelevant, roundabout, or self-defeating movements. This suggests closer relations and interrelations between physical, mental, and moral training than are usually recognized by teachers, or the trainers and governors of teachers. Since physical training aims at perfecting the body as an instrument and at rendering it the willing, prompt, and efficient

servant of an intelligent mind and a sensitive and enlightened soul, it cannot be gainsaid that physical training lies at the foundation of mental and moral training, or that it enters and must enter as a more or less prominent and necessary factor into the greater number of our educational procedures. The full success or failure of physical training, therefore, does not relate simply to the size or strength of the red meat we call muscles, but is measured in part by our achievements in the domain of mind, and the domain of conduct. In other words, we judge of the mental and moral worth of a man, by the purpose, number, consecutiveness, and skifulness of his ordinary and extraordinary acts, which acts, when viewed objectively and concretely, are reducible to the contractions of muscular fibres.

STRUCTURE OF HUMAN BODY, AND CLASSIFICATION OF ITS PARTS.

Regarded as a structure the human body is an aggregation of a vast number of living, individual cells which may be classified according to their pedigree, form, or function. These individuals are so grouped and joined together in our various organs that the body as a whole forms a communal structure, a sort of federal union of tissues and organs. Among machines it resembles an army or a city, rather than such mechanisms as an eight-day clock or a wind-mill. "Of this army," says Huxley, "each cell is a soldier, an organ a brigade, the central nervous system headquarters and field telegraph, the alimentary and circulatory system the commissariat. Losses are made good by recruits born in camp, and the life of the individual is a campaign conducted successfully for a number of years, but with certain defeat in the long run." Broadly speaking, an army is organized, equipped, fed, drilled, and led in order that its executive machinery — which in the last analysis consists of the skeletal muscles of its soldiers — may be enabled to transform the

largest possible amount of accumulated energy into the mechanical work of marching and fighting. So, in general terms, it may be said that the principal minor mechanisms found in the human body largely subserve the interests of the organs devoted to the performance of voluntary-purposive mechanical work, viz., the muscles.

It is the skeletal muscles and the skeleton, then, which constitute the executive working machinery of the body. But it is important to remember that no skeletal muscle is a simple organ. Every skeletal muscle is made up of two conjoined mechanisms: a contractile, executive mechanism, the muscle proper, and a stimulating, regulative mechanism consisting of nerve fibres and gray-matter nerve cells; that is to say, "a muscle" is fundamentally a muscle and a nerve besides. Or, to put it in another way, muscles are the slaves of the nerve centres. So close and necessary are the bonds existing between the muscular and nervous systems that, so far as our movements are concerned, the separate disjoined action of either system under ordinary circumstances is practically unthinkable. Muscles without their exciting nerves become inactive and inert, and nerves deprived of muscles to do their bidding are impotent.

The muscular and nervous tissues have been well termed "the master-tissues." All other tissues, omitting the indifferent and supportive tissues, such as bone and cartilage and connective tissues, may be classed under the head of "tissues of digestion," or "tissues of excretion," which are the terms used by the English physiologist, Michael Foster, who points out that "the whole of the rest of the body is engaged (1) in so preparing the raw food and so bringing it to the nervous and muscular tissues, that they may build it up into their own substance with the least trouble; and (2) in receiving the waste matters which arise in muscular and nervous tissues, and preparing them for rapid and easy ejection from the body."

The neuro-muscular system, then, has two sets of servants, its purveyors and its scavengers. The digestive and assimilative organs and the arterial section of the organs of circulation and respiration are "purveyors," and the venous section of the circulatory and respiratory organs, the perspiratory and the renal organs are "scavengers." The purveyor and scavenger-tissues serve each other as well as the master-tissues, it may be remarked, and, like the muscles, since they contain more or less of muscular tissue, are controlled by the Archaeus of the body, if we may so denominate the nervous system.

GENERAL EFFECTS OF MUSCULAR EXERCISE.

Next to the visible movements due to muscular contraction the most direct and obvious effects of neuro-muscular action are found in the increased circulation and ventilation of the blood. The effect of exercise upon the processes of digestion, blood-making, and blood-cleansing is an indirect one; those processes being modified, so far as muscular activity is concerned, by the changes wrought by it in the character, volume, and distribution of the general blood-stream. But the most important effect of muscular exercise, though it is too often overlooked, is to be found in the structural and functional improvement of the nervous system, or rather those parts of it which are concerned in the regulation and control of the skeletal muscles. It can hardly be too strongly emphasized that the full size and working power of the brain, spinal cord, and nerves depend very largely upon the normal working of their executive end-organs, the voluntary muscles.

What may be termed the gross-income of the bodily community is derived chiefly from the productive activity of its purveyor and scavenger members; though the master-tissues, whose leading function is the regulation of expenditures by reason of the active co-partnership existing between them

and their servants, materially assist towards the accumulation of the gross income-fund. It is preëminently the function of the master-tissues to turn the net-income of the body to the fullest and best account; which net-income, as has been said, is what remains from the gross-income after the fixed charges for construction, maintenance, and repair have been met. To secure the wise expenditure of net-income, therefore, it is needful to prevent the master-tissues from developing aimless, blundering or spendthrift habits of action. Prevention, in this instance, can only be secured through the intelligent and adequate training of the neuro-muscular system. If the development of ability to make intelligent and adequate use of the net-income of man's free energy be the main end of his education, it is tolerably clear that neuro-muscular education, or physical training, must constitute a considerable part of the measures directed to that end.

SPECIAL EFFECTS OF MUSCULAR EXERCISE.

The primary, essential, universal factor in all forms of physical training is neuro-muscular exercise. The effects of exercise upon a single muscle are chiefly two. On the one hand there results a general condition which may be termed the heightened health of the neuro-muscular machine, which state of health involves the attainment and maintenance of a normal degree of size, strength, and working power in its structural parts; and, on the other hand, a more complex and special effect; viz., the acquisition or organization by its neural parts of advantageous habits as regards the origination, transmission, and regulation of stimuli. The effects of exercise upon the muscular system as a whole differ in degree but not in kind from the effects of exercise upon a single muscle. The habitual movements having their seat in the various groups of muscles are said to be represented by the central masses of nervous tissue through whose stimulative action the muscles are animated or innervated.

THE HYGIENIC AND EDUCATIONAL ENDS OF EXERCISE.

The ends of exercise may be characterized, in a general way, as first the promotion of health, and second the formation of proper habits of action. The one is a hygienic end, while the other is a distinctively educational end. It matters not whether we consider a single muscle which admits of only a single limited motion, or a group of muscles, or a complicated system of muscular organs like the organs of speech, or the communal structure we call the body, or a class of school children, or a foot-ball team, or a regiment of soldiers — the ends of exercise are practically identical in each case, and can only be attained through a combination of hygienic and educational measures.

The main field of education is the nervous system, and the principles of all forms of education into which physical training enters as a factor are based upon the power of the nervous system to receive impressions and to register them or their effects; in other words, upon its ability to memorize the part it has played in acquired movements, and on occasion to revive and repeat such movements. The student of nervous disorders notes carefully the peculiarities of his patient's movements in order to determine the seat of his injury or weakness and the nature and extent of his disease. It is equally necessary that the practical teacher should apprehend the significance of the spontaneous and acquired muscular movements of his pupils, be those movements coarse or fine; since those movements constitute an index of the action of the brain which it is the teacher's business to develop and train, and also serve to measure the success and test the character of the teacher's efforts at instruction. This is true not only of instruction in foot-ball, military drill, gymnastics, sloyd, shoemaking, and sewing, but of instruction in drawing, singing, and the three R's as well. Genuine success in any of the departments of instruction mentioned above is

conditioned on the intelligence and skill of the instructor in selecting and teaching such forms of neuro-muscular action as are adapted to the sex, age, and capacity of his pupils.

The motor element in education is so large and of such vital importance that we hazard little in predicting that the systematic study of movements is destined to play a much more prominent part than has been accorded it hitherto, in the professional training of all classes of teachers. "It can scarcely be too often reiterated," says Mercier, an English alienist, in his "Nervous System and the Mind," "that the study of movements is the only means by which we can gain any insight whatever into the working of the nervous system."

CHARACTERISTICS OF CENTRAL AND PERIPHERAL MOVEMENTS.

As Mercier's work, cited above, contains the fullest and most satisfactory study of movements that has come under my notice, I am content to follow him in developing that part of my subject which relates to the classification of movements and the hierarchical arrangement of the nerve centres which "represent" them. As regards their regional relations our bodily movements may be characterized as central or peripheral. "By a central movement," says Mercier, "is meant, generally, a movement of the trunk. By a peripheral movement is meant, generally, a movement of the digits, mouth, or eyes; and the remaining parts of the body are classed in an intermediate position, and in one which approximates to the central or to the peripheral, according, generally, to the size of the part moved, and the size and individuality of the muscles concerned in the movement. . . . The movements here called central are continuous in duration, vague in limitation, few in number, same in character, and form a general, approximate or coarse adjustment. Progress toward the periphery brings us to movements that are more intermittent in duration, more precisely defined, more nu-

merous, more diversified, and more specially adapted to particular ends; and when at the eyes, the articulatory apparatus, and the digits, we reach the extreme periphery, all these characters reach their highest degree of development."

As typical central movements the following may be instanced; those principally concerned in breathing, standing, walking, running, riding, rowing, swimming, bicycling, and many gymnastic exercises; while typical peripheral movements include those involved in articulation, writing, drawing, engraving, watch-making, violin-playing, sewing, knitting, and the like.

Movements may be classified, also, as simultaneous or successive, the former being mainly central and the latter mainly peripheral in character. "Coördination in simultaneity affects the central movements first and most, spreads towards the periphery and affects the most peripheral movements last and least. Coördination in succession involves the most peripheral movements most often and in the most prolonged and complex sequences; and when, as often happens, the succession of movements begins centrally and spreads to the periphery it is the most peripheral movements to which all the others are subservient and act as aids and adjustments." As an example of successive movements beginning centrally, those concerned in vocal utterance may serve as an example. Vocal utterance is the resultant effect of the combined, *i.e.*, coördinated action of the organs of breathing, phonation, and articulation, which are situated in the chest, throat, and mouth respectively. Breathing movements are central, voice movements intermediate, and articulatory movements are peripheral. The most central movements in this series present two phases, viz., inspiration and expiration. In each phase the movements of abdominal wall, diaphragm, ribs, and glottis start simultaneously, but the enunciation of consonant and vowel sounds results from rapid successive movements of the vocal cords and of the tongue

and lips, — results, that is, from peripheral movements co-ordinated in succession.

The nervous mechanisms which innervate and represent our various movements have been divided according to their situation into lower, higher, and highest-level centres; and again they have been classed as fundamental or accessory according to the order of their development. In general we may say that the coarser, more central movements are represented in lower-level centres, *i.e.*, in the more central or basal regions of the brain and spinal cord; that the centres representing intermediate movements are found at higher places in the hierarchy than those which represent central movements; and that the highest-level centres, in the cortex of the brain, represent the most special, precise, elaborate, and varied of our peripheral movements.

THE EVOLUTION OF THE NERVOUS SYSTEM.

In the evolution of the race and of the individual, the more general functions and organs are formed and developed earlier than the special functions and their organs; *e.g.*, the circulatory and alimentary organs develop earlier than the vocal organs and the hands and feet. The same law obtains likewise in the growth and development of the nervous system, both as to its massive and its minute parts. The nervous mechanisms concerned in central movements are at once older and more lowly placed than the mechanisms concerned in peripheral movements. To those parts of the nervous system, in man, which are formed earliest and are practically completed and fully organized at birth, the late Dr. Ross, a leading English neurologist, gave the name "fundamental," while he designated as "accessory" those parts which are rudimentary at birth and comparatively late in their growth and development. Broadly speaking, central movements are represented by low-level, fundamental centres, and peripheral movements by high-level, accessory centres. If, as has been

stated, the nervous system is the field of education, education to be natural, safe, and effectual should defer the training of the accessory parts of the nervous system until the development of its fundamental portions has been secured by appropriate forms of general training.

HOW PHYSICAL TRAINING STRENGTHENS THE NERVOUS SYSTEM.

As is well known, city children as a class present more cases of nervous instability than do country children as a class. I therefore venture to quote at length Dr. Ross's views as to the part which physical training should play in the education of children with tendencies to nervous instability. "The children of parents who manifest a predisposition to severe nervous disease, as hysteria and epilepsy, are frequently not merely quick in their peceptive faculties but are also often possessed of great intellectual powers, and much of their future happiness depends upon judicious mental training in youth. The children of such families ought not to be subjected to any severe mental strain during the period of bodily development, or be allowed to enter into competition with other children in the mental gymnastics which are so fashionable in our public schools. On the other hand, regular graduated and systematic exercise in the form of walking, riding, gymnastics, and calisthenics does a great deal of good by strengthening both the muscular and nervous systems. Everything which tends to develop the muscles of the lower extremities and trunk, and indeed all muscles engaged in executing the movements common to both man and the lower animals, tends also to develop the fundamental part of the nervous system, and a good sound development of the fundamental is the first prerequisite to a well-balanced development of the accessory portion.

"The order of the development of the nervous system in the race has been from the fundamental to the accessory

portions; and no one can reverse this process with impunity in that further development of the individual which constitutes education in its widest sense. Yet until a few years ago the natural order of development was reversed in the education of youth, and especially in female education, so far as this could be accomplished by human contrivance and ingenuity. The natural order of development was indeed observed so far as to allow the child to acquire the power of walking prior to that of other accomplishments; but the care of the infant had not yet been transferred to the professional trainer. No sooner, however, had what is technically called education begun, than the professional trainer began to exercise the small muscles of vocalization and articulation so as to acquire the art of reading, the small muscles of the hand so as to acquire the art of writing, and in the case of young ladies the still more complicated movements necessary in running over the keyboard of a piano; while little attention was paid to the development of the larger muscles of the trunk and lower extremities, upon the full development of which the future comfort of the individual depends.

"In the education of youth in the present day the laws of development and physiology are not so openly violated and defied as they were a few years ago; but much remains to be done in this respect, and especially in the education of children of families who manifest a neuropathic tendency. In the children of such families the greatest possible care should be taken to develop carefully the fundamental actions, inasmuch as a sound development of these involves a stable construction of the fundamental part of the nervous system; a process which makes the latter to offer a greater specific resistance to the paroxysmal discharges from the later evolved centres of the accessory portions which underlie hysteria, epilepsy, and even many of the psychoses. The process of educating the accessory system, and especially the

higher centres of that system, should be regular and systematic; habits of mental scrutiny and self-examination — which, unfortunately, too many religious teachers deem necessary for the welfare of the soul — ought to be discouraged. In one word, education should be made as concrete and objective as possible."

THE LAWS OF DEVELOPMENT AND THEIR BEARING ON EDUCATION.

If this be true, and who shall gainsay it, is it not evident that educational measures of every kind should be selected and coördinated so as to conform to the order and rate of growth and development of the fundamental and accessory neuro-muscular mechanisms of the child and the adolescent? Is it too much to ask that educationists should recognize, ponder upon, and be guided by the laws of development which determine the health and power of the brain-centres, and the health and efficiency of the servants and ministers of those centres, namely, the skeletal muscles? It is true, doubtless, that the laws of development are recognized in a way, in the conventional division of schools into elementary, secondary, and superior; but it is no less true that the bodily and mental characteristics which differentiate children from youth, and both from adults, are deserving of more careful study and much fuller recognition than they have received, hitherto, from teachers as a class, or from those charged with the appointment and control of teachers.

At this point, I would call particular attention to some facts relating to the growth and death-rates of Boston children and youth of school age, since the facts in question seem to me to throw light upon the hygienic and educational needs pertaining to the developmental changes that culminate in full-grown organs and matured functional powers. Though authorities differ as to the age-limits of the successive phases of development which signalize the life of man

in the interval between birth and the attainment of maturity, the following division of that interval into periods is sufficiently accurate for our present purpose: (1) infancy, from birth till the first dentition at 7–9 months; (2) childhood, from the first till the second dentition at 7–8 years; (3) boyhood and girlhood, lasting from second dentition to puberty at 13–14 years: (4) puberty and adolescence, from 13 till the attainment of maturity at the beginning of the 25th year.

TABLE V.

SHOWING DEATH-RATES AND SPECIFIC INTENSITY OF LIFE AT INDIVIDUAL AGES, 0–21 YEARS, FOR EACH SEX IN BOSTON, IN THE CENSUS YEARS 1875, 1885, AND 1890, TAKEN TOGETHER.

Age.	Total Number living at each Age.			Total number of Deaths at each Age.			Death-rate per 1,000 living at each Age.			Specific Intensity of Life at each Age.			Age.
	1. Total Males and Females living at each Age.	2. Total Females living at each Age.	3. Total Males living at each Age.	4. Total Deaths of Males and Females.	5. Total Deaths of Females at each Age.	6. Total Deaths of Males at each Age.	7. Deaths per 1,000 Males and Females at each Age.	8. Death-rate per 1,000 F'males at each Age.	9. Death-rate per 1,000 Males at each Age.	10. Specific intensity of Life. Males and Females.	11. Specific intensity of Life. Females at each Age.	12. Specific intensity of Life. Males at each Age.	
0–1 years . .	24.120	11.997	12.123	6,707	3,074	3,633	277.61	256.24	299.51	3.59	3.90	3.33	0–1 years.
1–2 " . .	17.173	8.411	7.762	2,060	989	1,071	119.95	117.58	137.98	8.33	8.50	7.24	1–2 "
2–3 " . .	25.543	12.671	12.872	960	469	491	37.58	37.01	38.14	26.60	27.01	26.01	2–3 "
3–4 " . .	23.811	11.894	11.917	611	295	316	25.66	24.80	26.51	38.97	40.31	37.71	3–4 "
4–5 " . .	21.854	10.809	11.045	462	233	229	21.14	21.55	20.73	47.30	46.39	48.23	4–5 "
5–6 " . .	22.236	11.127	11.109	348	183	165	15.65	16.44	14.85	63.89	60.80	67.32	5–6 "
6–7 " . .	20.794	10.428	10.366	289	150	139	13.89	14.38	13.40	71.95	69.52	74.57	6–7 "
7–8 " . .	20.756	10.283	10.473	197	99	98	9.49	9.62	9.35	105.36	103.86	106.85	7–8 "
8–9 " . .	20.385	10.226	10.169	145	83	62	7.11	8.11	6.09	140.58	123.20	164.01	8–9 "
9–10 " . .	19.960	9.978	9.982	125	51	74	6.26	5.11	7.41	159.68	195.49	134.89	9–10 "
10–11 " . .	20.585	10.325	10.260	103	54	49	5.00	5.23	4.77	199.11	191.26	209.38	10–11 "
11–12 " . .	18.601	9.271	9.330	**70**	**30**	40	**3.76**	**3.23**	4.28	**265.72**	**309.03**	233.25	11–12 "
12–13 " . .	20.375	10.219	10.156	79	44	**35**	3.87	4.30	**3.44**	257.91	232.04	**290.16**	12–13 "
13–14 " . .	18.871	9.560	9.311	98	59	39	5.19	6.17	4.18	192.55	162.03	238.74	13–14 "
14–15 " . .	20.390	10.112	10.278	100	59	41	4.90	5.83	3.98	203.90	171.39	250.68	14–15 "
15–16 " . .	19.776	10.180	9.596	111	60	51	5.61	5.89	5.31	172.10	169.66	188.15	15–16 "
16–17 " . .	20.824	10.798	10.026	137	71	66	6.57	6.57	6.58	152.00	152.08	151.90	16–17 "
17–18 " . .	20.612	10.824	9.788	149	86	63	7.22	7.94	6.43	138.33	125.86	155.36	17–18 "
18–19 " . .	23.025	10.650	10.375	218	80	108	9.46	6.32	10.40	105.61	158.12	96.06	18–19 "
19–20 " . .	22.840	12.206	10.634	237	128	109	10.37	10.48	10.25	96.36	95.35	97.55	19–20 "
20–21 " . .	25.431	14.817	10.614	222	103	119	8.72	6.95	11.21	114.55	137.73	89.10	20–21 "

DIFFERENCE BETWEEN BOSTON BOYS AND GIRLS IN RESPECT TO DEATH-RATE.

The above table is introduced to show that the death-rates of Boston boys and girls differ from each other, particularly as to the years in which the lowest death-rate falls. Later on it will be shown that there is an important relation between the death and growth-rates of Boston boys and girls which in general terms is as follows: *during the period from 10–15 years, the years characterized by most rapid increase in height and weight, are years in which the fewest deaths occur.*

The data contained in columns 1–6 on which the death-rates in columns 7–9 have been computed, are given for the reason that the same or similar data cannot be found, so far as I can learn, in any of the statistical publications of the State of Massachusetts or of the city of Boston. The data relating to total number of deaths found in columns 4–6 are derived from the official records kept in the office of the Secretary of the Commonwealth, and are here compiled and published for the first time. I desire to acknowledge my obligation to Secretary Olin, for allowing my representative access to the official records during the period requisite, viz., three weeks, to compile the figures in column 4–6.

I am under special obligations to Hon. Carroll D. Wright, U.S. Commissioner of Labor in charge of the Census Office, Washington, for returns showing by sex and individual ages the number of persons in Boston, in 1890, which he kindly furnished me in advance of publication; and to Horace G. Wadlin, Esq., Chief of the Bureau of Statistics of Labor of Massachusetts for similar returns derived from the Massachusetts census returns of 1875 and 1885. But for the kindness of those gentlemen, it would have been impossible for me to compile Table V., or to show the cor-

relation which seems to exist between the death and growth rates of Boston children.

Many years ago Dr. William Farr called attention to the fact that the death-rates of English children fell to their lowest point in the period 10–15 years, in which puberty is established, and rose thereafter. That the period 10–15 is the half-decade in all human life in which fewest deaths occur to a thousand living is illustrated in the vital statistics of all civilized countries. It is therefore not surprising that the death-rates of Boston children, from their eleventh to their fifteenth years inclusive, should be lower (see column 7) than in any other of the five-year periods included in the table.

The most important fact disclosed in the above table seems to be this, viz.: that *the years of lowest death-rate, i.e., of greatest power to resist disease, are not the same for the two sexes.* In the case of girls that year is the twelfth; for boys it is the thirteenth; for boys and girls taken together it is the twelfth. That girls should reach their maximum of vigor a year earlier than boys seems to harmonize with the fact that they develop earlier than boys, both bodily and mentally.

The year of lowest death-rate is not invariably the same, but so far as we have any light on this question, *i.e.*, so far as the data on which Table V. is based are concerned, Boston boys are always later by at least one year in reaching their maximum immunity from disease and death. In two of the years under consideration, viz., in 1885 and 1890, the lowest death-rate of boys falls two years later than that of girls. The lowest death-rate and the year of age in which they fall for Boston children is as follows:

	1875.	1885.	1880.	1875-90.
Boys and girls .	2.85 12th year.	3.87 12th year.	3.17 13th year.	3.76 12th year.
Girls	2.28 " "	3.32 " "	3.19 " "	3.23 " "
Boys	2.75 13th "	3.93 14th "	2.86 15th "	3.44 13th "

I am unable to cite any comparative study showing the year of lowest death-rate of boys and girls belonging to different races; but it is safe to assert that the difference in this respect shown to exist in the case of Boston children is neither a fortuitous difference nor a difference peculiar to them, since such study as I have been able to make of the individual-age death-rates of Berlin, Norwegian, and Swedish children leads to similar results. The main purpose of Table V. is to furnish a basis for comparing the death and growth-rates of Boston children with each other, as growth and death-rates are generally inversely proportional to each other. For the sake of making a direct comparison I have computed the specific intensity of life at each age for both sexes (see columns 10–12). Since it is the ratio of the number dying to the number living at each age, specific intensity of life serves to express the immunity from death of any given age-class. It culminates in the year of lowest death-rate.

TABLE VI.

SHOWING THE RELATION OF GROWTH-RATE IN HEIGHT AND WEIGHT, TO SPECIFIC INTENSITY OF LIFE OF BOSTON CHILDREN 5 TO 18 YEARS OF AGE, IRRESPECTIVE OF THE NATIONALTY OF THEIR PARENTS, BY INDIVIDUAL AGES AND SEX.

Age.	Height.						Specific intensity of Life 1875-'85-'90.		Weight.						Age.
	Height in Centimeters.		Average yearly increase in Centimeters.		Per cent. yearly increase in Centimeters.				Weight in Kilograms.		Average yearly increase in Kilograms.		Per cent. yearly increase in Kilograms.		
	1. Girls.	2. Boys.	3. Girls.	4. Boys.	5. Girls.	6. Boys.	7. Girls.	8. Boys.	9. Girls.	10. Boys.	11. Girls.	12. Boys.	13. Girls.	14. Boys.	
5-6	104.9	105.6	5.2	5.5	4.00	5.20	60.08	67.3	17.99	18.64	1.6	1.9	8.88	10.25	5-6
6-7	110.1	111.1	5.5	5.1	4.08	4.58	69.5	74.5	19.63	20.49	1.9	1.8	9.69	8.78	6-7
7-8	115.6	116.2	5.3	5.1	4.58	4.38	103.8	106.8	21.53	22.26	1.9	2.2	8.83	9.86	7-8
8-9	120.9	121.3	4.5	4.9	3.72	4.08	123.2	164.0	23.44	24.46	2.5	2.4	10.68	9.79	8-9
9-10	125.4	126.2	[1]**5.0**	5.1	[1]**3.98**	4.04	[1]**195.4**	134.8	25.91	26.87	2.4	2.8	9.26	10.40	9-10
10-11	130.4	131.3	[2]**5.3**	4.1	[2]**4.06**	3.12	[2]**191.2**	[1]**209.3**	28.29	29.62	[1]**2.9**	2.2	[1]**10.24**	7.43	10-11
11-12	[1]**135.7**	135.4	[3]**6.2**	[1]**4.6**	[3]**4.56**	[1]**3.39**	[3]**309.0**	[2]**233.2**	31.23	31.84	[2]**4.3**	[1]**3.1**	[2]**13.78**	[1]**9.74**	11-12
12-13	[2]**141.9**	140.0	[4]**5.8**	[2]**5.3**	[4]**4.08**	[2]**3.78**	[4]**232.0**	[3]**290.1**	[1]**35.53**	34.89	[3]**4.7**	[2]**3 6**	[3]**13.23**	[2]**10.31**	12-13
13-14	[3]**147.7**	145.3	[5]**4.6**	[3]**6.8**	3.11	[3]**4.68**	162.0	[4]**238.7**	[2]**40.21**	38.49	[4]**4.4**	[3]**4.5**	[4]**10.94**	[3]**11.66**	13-14
14-15	[4]**152.3**	152.1	2.9	[4]**6.1**	1.90	[4]**4.01**	171.3	[5]**250.1**	[3]**44.65**	42.95	[5]**3.5**	[4]**5.6**	7.83	[4]**13.02**	14-15
15-16	155.2	158.2	1.2	[5]**6.9**	0.77	[5]**4.36**	169.3	188.1	48.12	48.59	[6]**2.7**	[5]**6.3**	5.61	[5]**12.96**	15-16
16-17	156.4	165.1	0.8	2.9	0.51	1.75	152.0	151.9	50.81	54.90	1.6	[6]**2.9**	3.14	5.23	16-17
17-18	157.2	168.0	0.1	1.3	....	0.77	125.6	155.3	52.24	57.84	....	2.3	....	3.97	17-18

The figures printed in bold-faced type serve to emphasize the leading features of the period of acceleration in growth and specific intensity of life.

The salient facts disclosed by Table VI. are these: (1) the period 10–15 years of age is, for Boston children, at once a period of accelerated growth and of accelerated specific intensity of life; or in other words it is the period in which Boston children attain and pass the flood-tide of growth and of their vitality, as measured by their power to resist death; (2) acceleration of growth and of specific intensity of life set in, culminate, and begin to decline earlier for girls than for boys.

So far as growth-rates are concerned this table is based upon the results of the investigation of Dr. H. P. Bowditch, Professor of Physiology in the Harvard Medical School, in regard to the height and weight of 24,595 children (13,691 boys and 10,904 girls) belonging to the public schools of Boston, in the year 1875. Dr. Bowditch's investigation was made by permission of the School Committee and through the co-operation of the principals of schools. Dr. Bowditch was the first to show, on a large scale, that the growth-rates of boys and girls differ from each other. Though the practical bearing of Dr. Bowditch's results has been but feebly grasped by American educationists, his results have been confirmed by numerous scientific investigations in Europe and by a few in the United States. Judging by the frequency with which Dr. Bowditch's results are cited by English, German, Russian, Italian, and Swedish writers, it would appear that those results are more widely known and more highly estimated than any other fact connected with the management of the public schools of Boston.

In this table, figures relating to height and weight are iven in centimeters and kilograms respectively. The figures relating to specific intensity of life are taken from Table V. As the actual rate of growth is more accurately expressed in terms of the relative average-increase in height and weight, than in terms of the actual increment of those variables, I have computed and interpolated the figures

contained in columns 5, 6, 13, and 14. The figures in columns 3, 4, 11, and 12 show the average *amount of growth*. Those in columns 5, 6, 13, and 14 show the average *rapidity of growth* year by year. The figures in columns 1–4 and 9–12 are either taken directly from Dr. Bowditch's tables, published by the Massachusetts State Board of Health, or from Dr. Axel Key's reproduction of those tables in terms of the metric system of numbers.

Inspection of the table, columns 1 and 2, shows that girls are taller than boys of corresponding age during *four* years, viz., 11–14, inclusive; also that the accelerated yearly increase (see columns 3 and 4) in height begins at 9 years for girls and at 11 years for boys; that it culminates in the 12th year for girls and two years later for boys; and ceases in the girls' case at 14, and in the boys' case at 16: and that the growth-rate of the two sexes, given in columns 5 and 6, corresponds closely, though not absolutely, with the rates given in columns 3 and 4.

In respect to weight we find that the girls are heavier than the boys for the *three* years 12–14 inclusive (see columns 9 and 10); also that the accelerated yearly increase in weight begins for girls at 10 and at 11 for boys (see columns 11 and 12), that it culminates in the 13th year for girls and in the 16th for boys, and terminates at 16 for girls and 17 for boys; and that with regard to the percentage growth-rate in weight, expressed in columns 13 and 14, the same condition exists which was noted above in regard to the percentage growth-rate in height.

In respect to specific intensity of life, that of girls maintains a relatively high level from 9–12 inclusive, culminating at 11–13; while that of boys maintains a high level from 10–15, having its culmination at 12–13.

CORRELATION OF GROWTH-RATES WITH DEATH-RATES.

Summarizing the statements contained in the last three paragraphs, we may say that pre-pubertic acceleration of growth in height and weight begins and culminates earlier, and is less prolonged in the case of girls than of boys; and that in each case the period of greatest and most rapid growth is the period marked by the highest specific intensity of life, or of lowest mortality.

The year of least mortality and of most rapid growth, both in height and weight, is the twelfth year for girls; while for boys, the thirteenth is the year of least mortality, the fourteenth that of most rapid growth in height, and the fifteenth that of most rapid growth in weight.

The above table shows that specific intensity of life and rates of growth in height and weight decline markedly for both sexes after the sixteenth year. This fact suggests the importance not only of minimizing all influences which hinder, but also of magnifying all agencies which are effective in promoting the growth of school children before their tide of exuberant vitality and of active growth begins to ebb. In affairs of growth and development, as in the "affairs of men," it is the flood-tide, and not the ebb, which "leads on to fortune."

GROWTH AND DEVELOPMENT.

Our "earthly pilgrimage" embraces three stages, viz., (1) that of Evolution or Immaturity, which is *par excellence* the period of growth or increase in size, of development or improvement and increase of functional powers, and of storage of energy; (2) that of Maturity or Completed Development, in which growth and development proceed more and more slowly till they cease, a period of productive activity, of balanced income and expenditures of energy; and (3) that of Dissolution or Decline, marked by excess of expend-

iture of energy, by weakened and decaying functions, and by wasting and degeneration of organs and tissues.

Growth and development characterize the stage of immaturity, as has been said, but since development waits upon growth, the two processes vary in amount and rate in different parts of that stage, considering the body as a whole. Nor should it be forgotten that the several somatic and special mechanisms of the body differ in respect to the order and rates of their growth and development. If the education of children and youth shall ever become thoroughly natural and rational, it will be because the significance of that order and rate, and their relations to life and death, are recognized and heeded to an extent that is nowhere common as yet.

The leading somatic organs emerge from the rudimentary chaos of early fœtal life in the following order, practically speaking: the brain and nervous system; the alimentary system; the circulatory and respiratory systems; the muscles and the skeleton. And after birth the brain maintains its lead both in growth and development over the muscles, until the period of second dentition at 7–8 years of age, when the brain weighs, within a narrow margin, as much as it ever will. In the brain, the parts which preside over the sense organs appear sooner and develop earlier than do the parts which control the motor organs. Complete development of motor ability does not and cannot take place until the muscular instruments or end-organs of the motor brain-centres have attained full growth, which is not accomplished till puberty. The skeleton is not fully consolidated until the twenty-fifth year.

The growth-rates thus far considered are used to express the growth of the body as a whole; but as a matter of fact increase in height is chiefly an increase of length in the skeleton, and growth in weight consists mostly of increase in the weight of the muscles. The adult body is about

three times as tall and twenty times as heavy as that of the infant at birth. Certain facts relating to the growth-rate of some of the leading somatic organs remain to be considered. The following figures, showing the changes brought about by growth, during the stage of evolution, in the ratios of the weight of the brain, the muscles, and the skeleton to the total body-weight, are taken from Foster's Text-Book of Physiology:

Weight of brain in new-born babe	=	14.34%,	in adult	=	2.37	of body-weight.		
" skeleton	"	"	= 16.70%,	"	= 15.35	"	"	
" muscles	"	"	= 23.40%,	"	= 43.10	"	"	

In other words, in the adult the brain is 3.7 times, the skeleton 26 times, and the muscles 48 times heavier than at birth. It is obvious that if the musculature fails to attain its normal size and weight, the body cannot attain its full size and weight. It is scarcely necessary to urge in the face of such facts that well-directed muscular exercise may powerfully promote normal bodily growth.

MENTAL AND BODILY CHANGES PECULIAR TO THE STAGE OF IMMATURITY.

The stage of evolution or immaturity is of paramount importance, since the formal education of the vast majority of the pupils in our elementary and secondary schools ceases before maturity is reached. This stage may be roughly divided into three equal periods of eight years. Both growth and development proceed during each period, but growth preponderates in the first and second, and development in the third period. The salient features of each period may be grouped as follows:

First Period. — From birth till the close of the eighth year. The whole body grows rapidly in the first two years of life, more particularly in the first year, but it is the "immense" growth of the brain — which attains its full weight

within a few ounces in the eighth year — that signalizes this period most markedly. In the domain of development the sensory organs take the lead and reach a high degree of perfection, though certain of the most essential neuro-muscular mechanisms concerned in the coördination of relatively central movements, also undergo active development, *e.g.*, those concerned in equilibration, locomotion, and vocal utterance. The child is imitative, inquisitive, and acquisitive; but his perceptive powers and his memory develop faster than his powers of discrimination and expression. During this period sensory education may safely be diversified and somewhat specially emphasized; but motor education should be of a more general and elementary character.

Second Period.— From the beginning of the ninth to the end of the sixteenth year. This is distinctively the period of most rapid growth in height and weight. In increase of weight the muscles play the leading part. Motor coördinations reach a higher degree of development than were possible during the preceding period, though they are not fully perfected till adolescence is nearly completed. "The process of perfecting motor coördinations cannot be said to be complete," says Dr. Clouston, "while the awkward, ungraceful motions of hobbledehoyhood last, and until we reach the grace and poetry of body-motion of the maiden of twenty-three, and the dexterity, force, and swiftness of coördination of eye, hand, and body seen in the male cricketer or lawn-tennis player of five-and-twenty." As Dr. Clouston has pointed out, one of the most marked features of this period is the coördination of motion and emotion.

In this period the individual diverges from the neutral condition of childhood and takes on the distinctive characteristics of youth or maiden. The changes in body, mind, and character which result from the establishment of puberty are profound and lasting in both sexes, though they transpire more rapidly and proceed further in the gentler sex in this period.

Self-consciousness is awakened, self-confidence is quickened, and new impulses, appetencies, and ambitions arise which prompt the adolescent to try all things and every body. The child yields to authority and accepts dicta with comparatively good grace; but the youth demands reasons and must be convinced, or at least persuaded, by his teachers and governors — he may be led, but he resists being driven. Educational methods, therefore, particularly during the second half of this period, should savor more of incitement than compulsion. The formal education of the great majority of public-school pupils terminates in this period, since so soon as they are fairly well-grown their services become marketable. Those who are destined to the ruder forms of labor or the humbler crafts and occupations enter the lowest ranks of wage-earners, while as yet the privileged youth selected by their parents or by circumstances to engage in pursuits which demand special aptitudes or technical training are too undeveloped, in most instances, to make rational choice of a vocation.

On the whole, since the period of most active growth appears to be followed by one of comparative exhaustion, when the organism is peculiarly susceptible to disturbing and deterrent influences, the second may be considered, from the hygienic standpoint, as the most critical of our three periods. Exhausting constitutional disease, excessive mental or bodily exertion, under-feeding, ill-judged deprivation of muscular exercise, may readily lead to irremediable stunting or enfeeblement, especially in those who are city-born and city-bred. If physical education be neglected or misdirected during this period, if it be deferred to a more convenient season, it cannot accomplish its perfect work either as regards the promotion of health or the development of the motor powers of the brain.

Third Period. — From the beginning of the seventeenth to the close of the twenty-fourth year. This, the period of

established adolescence, is distinctively a period of development, — of development of character as well as of bodily and mental faculty. The life of the race begins to be reflected in the life of the individual, — to whom a higher and wider range of activities is opened through the development and perfecting of his higher fundamental and accessory neuro-muscular mechanisms. Emotion is coördinated with self-chosen aims and ideals: self-directed actions increase in number and effectiveness; and the individual is prepared by special forms of technical training to enter upon his life-work as an adult, independent member of society.

During intra-uterine life, the human being passes through phase after phase of development, in which some features of the organism resemble the adult structures of certain lower forms of animal-life. Similarly the adolescent, in the stage of his advancing development, passes through phases of thought and feeling that savor strongly of semi-civilized and barbarian culture. He epitomizes, so as to speak, the developmental history both of his nearer and remoter ancestors. For not a few the stress and struggles of development prove a breaking strain, and adolescent insanity results.

SUMMARY VIEW OF PERIODS OF IMMATURITY.

During the stage of immaturity the natural course of events seems to be as follows: brain growth, which is the leading event in the first period, culminates in the seventh or eighth year; and the most rapid development of the sensory organs and the perceptive faculties, which determine the elaborateness, complexity, and precision, in short, the efficiency of our movements, takes place in the same period. The muscles, which are to serve as the executive instruments of the brain, do not attain full growth till towards the end of the second period. Then, when both brain and muscles are fully grown, neuro-muscular development enters upon its most active and important stage, *i.e.*, in the third period. Measures

that directly promote growth are mainly hygienic measures, and measures that directly promote development are mainly educative. An intelligent combination of hygienic and educative measures is called for, both in the sensory and motor education of the individual, during each and all of the three periods; but, during the whole of the first and the first half of the second period, hygienic forms of exercise should preponderate, while during the last half of the second and the whole of the third period educative forms of exercise should be assigned the leading part, — provided that practically normal growth and health have been secured to start with.

EDUCATIONAL REQUIREMENTS PECULIAR TO STAGE OF IMMATURITY.

Elementary education is naturally assigned to the first and second periods. Secondary education usually begins in the second, and either terminates in the third or merges into superior or technical education. According to the statistical tables contained in Superintendent Seaver's last report, the elementary public schools of Boston, on January 31, 1894, included upwards of 94 per cent. of all the pupils in the day schools, while less than 6 per. cent. were found in the secondary schools. Classifying the 65,588 pupils in question in accordance with the age-scale used above, it appears that 26.8 per cent. of them are in the first, 67.5 per cent. in the second, and only 5.69 per cent. in the third period of immaturity. It is plainly obvious, then, that the main work of our schools is elementary and general, and that training and not culture should be their end and aim. Culture presupposes and is based upon fully developed and disciplined powers, which are precisely the powers that the pupils in elementary and secondary schools lack. It is therefore a misleading use of language to apply the term "physical culture" to school-gymnastics and school-sports. Physical training is what our school-children need, but have never had in the

measure adequate to their needs. It may be that the day will come when our colleges and universities shall undertake the "physical culture" of their students; but their efforts will be barren and fruitless unless they shall first induce the secondary schools to do what comparatively few of them even pretend to undertake at present, viz., provide intelligently and adequately for the physical training of the youth they profess to educate.

THE LEADING PRINCIPLES OF PHYSICAL TRAINING AND THEIR IMPORTANCE.

If it be true, as I have endeavored to show in the preceding pages, that the neural element is a necessary and dominant factor in muscular exercise, so called; that muscular movements serve as an index of the constitution and condition of motor brain-centres, and may be made to serve as a means of securing the orderly and natural growth and development of those centres; that there is a definite order of evolution in the neuro-muscular mechanisms, as in the other somatic organs; that the growth-rates of the body and brain are correlated with their power to resist disease; that the fluctuations in specific intensity of life and rates of growth of the two sexes vary in height and amplitude during the second period of immaturity; and that the ages of more than two-thirds of the pupils in the public schools of Boston fall within the period just mentioned, — it will hardly be gainsaid that the principles underlying systematized muscular exercise — which is physical training — are worthy of serious and careful consideration from all who are intrusted with the responsibility of determining the policy, or of administering the practical affairs of elementary and secondary schools.

It is implicitly and explicitly denied by many that education is a science as well as an art. American educationists, as a class, have been rather disinclined to accept and apply

the plain teachings of modern physiology and psychology with regard to the natural history of man, and the mutual interdependence of his bodily and mental parts. It is perforce a slow and difficult matter for a class, whose leaders are not fully emancipated from the thraldom of an arrogant and overweening humanism, to readjust their aims and methods so that they shall harmonize with the results of proven science. It is vastly easier for them to regard the rising generation as mere adults in miniature, and to judge, admonish, and instruct children and youth in accordance with the standards of mental and moral excellence that obtain among men and women, than it is to ascertain the essential characteristics which differentiate the child from the youth and both from adults, and to employ only such methods as are natural and appropriate to the age, sex, and individual peculiarities of their pupils. Moreover, "practical educators have been loth to admit the legitimate claims of physical education, either as a branch of practical hygiene, or as a pedagogic discipline, for the reason that the subject has been ridiculously exploited, at times, by doctrinaires and dabblers as a safe, sure, and speedy means of hastening the millennium.

The motor element in all forms of instruction and practice is so large and vital; physical education has so many points of contact and such numerous and intricate relations with mental and moral training; the range in which its principles are applicable is so wide and diversified; and critical, comprehensive views regarding its nature and limitations are so little in demand, that the larger and more weighty claims of physical training to the dignity and privileges of a coördinate department of education easily fail of recognition in the confusion due to the conflicting and often preposterous claims of the partisans of one or another "system," on the one hand, and of self-elected "professors" and practitioners of one or more of the thousand and one minor subdivisions of physical training on the other.

SIGNIFICANCE OF THE TERM "PHYSICAL TRAINING."

It seems to me that, as it is generally employed, the term "physical culture" is a misnomer, and that it had better be eschewed, when one undertakes to discuss the forms of muscular exercise that are best adapted to meet the needs of pupils in elementary and secondary schools; since it is not properly synonymous with the terms "physical training" and "physical education" which are interchangable according to the best usage. Moreover, as usage varies not a little with regard to the two terms last mentioned, it may be well to consider their significance before proceeding further. The term "physical education" has been frequently employed to signify all such measures as are classed by the best writers, along with exercise, under the head of personal hygiene, *e.g.*, dress, diet, bathing, etc. When employed in this sense the term manifestly means too much. Whereas, when physical training is made to include only such particular forms of exercise as respiratory gymnastics, elocutionary drill, Delsarte exercises, massage, posturing, the manual-of-arms, cudgel or sword-play, or the inchoate games that serve for the recreation of school-children at recess-time, the term means too little. For our present purpose, physical training may be defined as the regulated practice of some form of muscular exercise, under such conditions as serve to promote the health of the organism or to develop and discipline its motor functions, either in a general or special way.

GENERAL AND SPECIAL FORMS OF PHYSICAL TRAINING.

Inasmuch as muscular exercise is resorted to for a variety of purposes, its aims may be classified as recreative, hygienic educative, and remedial. In its wider sense physical training, therefore, includes childish games, athletic sports, gymnastics, manual training, and all forms of exercise that

are employed, of set purpose, to develop motor ability of a special or professional sort. Success in language-training, or in military, manual, and industrial training, is conditioned on the intelligence and skill with which the principles of physical training are applied by the teachers of those arts; since it is through the assiduous drilling of their neuro-muscular mechanisms that actors, elocutionists, musicians, marksmen, draughtsmen, and penmen, as well as ploughmen, boatmen, soldiers, and craftsmen are enabled so acquire their technique.

The great majority of the pupils in our schools are too unripe to profit from such mental training as is mainly technical; accordingly our schools are wisely organized for general and preparatory training. In the domain of physical education it is equally important not to confound general and special training either in thought or practice. Reason and experience forbid the substitution of military drill, sloyd, manual or elocutionary training for gymnastic and athletic training, or *vice versa*. It is unfortunate, to say the least, that the ardent advocates and promoters of specialized forms of motor education so often fail to appreciate the necessity of conforming their measures and methods to the laws of nature. The introduction of sloyd and manual training and of military drill into the curriculum of urban schools enhances and intensifies the need of school gymnastics and athletics, since it is demonstrable that sloyd, manual training, and the manual of arms, unless they are based upon and accompanied by sound bodily training of a more general nature, tend to produce awkwardness and deformity. Competent experts in surgery, ophthalmology, and hygiene have shown that the customary systems of school-seating and the conventional methods of teaching penmanship are largely responsible for much of the impaired vision and spinal curvature found among school-children. It is devoutly to be hoped that such intrinsically valuable branches of physical

education as sloyd and manual training shall not, through haste and heedlessness, be rendered liable to similar criticism and attack.

Physical training, though an ancient art, is so new a science that even its most zealous advocates must admit that very much remains to be done before an exhaustive and absolutely satisfactory statement as to the hygienic and educational values of its leading general and special forms can be drawn up; but this condition of affairs does not justify indifference or aversion to efforts already initiated in various parts of the world for making good the losses which accrue to city children, as a class, from the deprivation of adequate facilities for play and exercise in the open air. Enough is known and has been proven by experience with regard to the nature and effects of muscular exercise, to warrant much more vigorous and comprehensive measures than have been taken as yet in any American city, to secure the benefit of appropriate forms of physical training to the pupils in all grades of the public schools. To this end, all efforts to add to the number of baths and of swimming-schools, of play-grounds and gymnasia, or to enhance the efficiency of those we have, should be heartily seconded and promoted. If it were the custom in Boston, as in many foreign cities, to provide the public schools with spacious grounds, well adapted to serve as play and gymnastic grounds, our school-yards could be made much more serviceable than is at present possible, in the interests both of formal and informal physical education.

CHARACTERISTICS OF OUR PRESENT SYSTEM OF SCHOOL GYMNASTICS.

Our present system of school gymnastics is good so far as it goes, but it is from the nature of circumstances necessarily restricted in its range, since leaving out of account girls' classes belonging to the Charlestown and Brighton High Schools, which are specially privileged in having small

collections of Swedish gymnastic apparatus, no provision has been made for instruction outside of the single branch of the so-called "free-standing-movements," which do not require apparatus of any sort. Free-standing-movements are invaluable in the preliminary motor education of the child, and should not be neglected during the two later periods of immaturity — as they afford a ready and effectual means of developing the principal forms of motor coördination, which are requisite to acquiring normal habits of carriage in sitting, walking, running, and jumping. But free-movements alone do not fully meet the bodily and mental needs which characterize the phase of adolescence, in which are found the majority of our pupils who belong to the high school and the two upper classes of the grammar-school grades. Hence all pupils above the second class of the grammar school should have instruction in Swedish apparatus-gymnastics, which are more effectual than free-movements in promoting growth and the development of agility, strength, endurance, and the higher forms of presence of mind and self-control. So long as apparatus-gymnastics do not constitute an organic part of our school gymnastics, so long will it be idle to claim that the vote of the school committee ordering "*that the Ling or Swedish system of school gymnastics be introduced into all the public schools of this city*" has been carried into effect. It would be easily practicable to expand our present partial and rudimentary system of physical training into a comprehensive system that should be practically adequate to the needs of all classes of pupils. *The question here is one of will, not of way.* Possibly, if Boston school children were as amply provided with play-grounds, gymnasia, and instruction in sports and gymnastics as those of Berlin, our City Registrar would have occasion to record fewer deaths, and more births as time elapsed. Our average excessive loss of school-children, judged by the Berlin standard of specific intensity of life, at present amounts to one hundred lives annually.

THE CHARACTERISTICS OF ATHLETICS AND GYMNASTICS — NEED OF BOTH IN A BROAD SCHEME OF PHYSICAL TRAINING.

Experience shows that out-of-door games, athletic sports, and systematic gymnastics are the forms of exercise which yield the best results in the physical training of school children. The plays of the kindergarten, the athletic sports to which British and American youth are so devoted, and the systematized gymnastics of the Swedes and Germans, have all developed from one germ — from healthful play ; the vital energy of that germ is found in the universal and ineradicable impulse of all healthy children to play.

In the athletic sports of young men, we see the highest and fullest expression of the play instinct. The most essential difference between athletics and gymnastics is one of aim. The aim of athletics, unless they are of the illegitimate professional sort, is pleasurable activity for the sake of recreation ; that of gymnastics is discipline or training for the sake of pleasure, health, or skill. We have but to compare the aims, methods, and results of each, and to call to mind the characteristics of the peoples that have most affected athletics on the one hand and gymnastics on the other, to perceive that gymnastics are more highly developed and present more features of educational value, where large numbers are concerned. Gymnastics as compared with athletics are more comprehensive in their aims, more formal, elaborate, and systematic in their methods, and are productive of more solid and considerable results under the artificial and restrictive conditions of city life. I have no disposition to disparage athletic sports. I would that they were more general and better regulated than they are in our country. I believe that they are valuable as a means of recreation, that they conduce to bodily growth and improvement, and that their moral effects may be of great value, since they call for self-subordination, public spirit, and coöperative effort,

and serve to reveal the dominant characteristics and tendencies as regards temper, disposition, and force of will of those who engage in them. But athletics bear so indelibly the marks of their childish origin, and are so crude and unspecialized and expensive in their methods, as to render them inadequate to meet the requirements of a thorough-going and comprehensive system of bodily education. The requirements of such a system demand a judicious admixture of sports and gymnastics, of free play and formal guidance, to the end that each may help and reënforce the other.

No comprehensive system of physical training can be considered safe or rational whose exercises are not chosen and ordered so as to meet the varied and changing needs, in respect to their sex, age, health, strength, and mental capacity, of the individuals to be trained. The results which should be secured by such a system are briefly these: easy and graceful carriage of the head and limbs; a broad, deep, and capacious chest, in which the heart and lungs, developed to their normal size and strength, shall have free, full, and regular play; square shoulders; a straight back; fully developed and well-rounded limbs; and the power to execute with ease, precision, and economy of force such movements as are involved in habitual actions, in the simpler exercises calling for strength and skill, and in the performance of ordinary gymnastic and athletic feats.

IMPORTANCE OF THE EDUCATIONAL EFFECTS OF EXERCISE.

It is well to emphasize the beneficial effects of muscular exercise upon the nutrition of the body and its component parts, since in the last analysis health is very largely a matter of nutrition. I am not disposed to deny that ample justification for making physical training a coördinate branch of instruction in city-schools is to be found in the undoubted efficacy of muscular exercise to promote general bodily

health; but equally weighty arguments for the efficient organization and generous support of physical training may be derived from the educational value of systematized muscular exercise. Indeed, I am convinced, both from reflection and observation, that the hygienic ends of physical education cannot be attained in full measure by instructors and trainers who do not recognize and strive to realize its educative ends as well.

DU BOIS-REYMOND ON THE NERVOUS ELEMENT IN EXERCISE.

Most teachers, unfortunately, derive their notions of exercise from text-books on physiology, since, hitherto, the normal schools have failed, for the most part, to furnish their pupils with sound and thorough instruction in either the theory or the art of physical training. "We seek in vain," says Du Bois-Reymond, the veteran professor of physiology in the University of Berlin, "in most physiological text-books for instruction respecting exercise. If it is given, only the so-called bodily exercises are generally considered, and they are represented as merely exercises of the muscular system; therefore it is not strange that laymen in medicine, teachers of gymnastics, and school teachers believe this. Yet it is easy to show the error of this view, and to demonstrate that such bodily exercises as gymnastics, fencing, swimming, riding, dancing, and skating are much more exercises of the nervous system, of the brain, and spinal marrow. It is true that their movements involve a certain degree of muscular power; but we can conceive of a man with muscles like those of the Farnesian Hercules who would yet be incompetent to stand or walk, to say nothing of his executing more complicated movements. For that we have only to add to our conception the power of arranging the motions suitably, and of causing them to work harmoniously. . . . All the bodily exercises we have mentioned above are not mere muscle-gymnastics, but also, and

that preëminently, nerve-gymnastics, if, for brevity, we may apply the term, nerves, to the whole nervous system. . . . Man is adapted to self-improvement by means of exercise. It makes his muscles stronger and more enduring; his skin becomes fortified against all injury; through exercise his limbs become more flexible, his glands more productive; *it fits his central nervous system for the most complicated functions; it sharpens his senses; and by it his mind, reacting upon itself, is enabled to augment its own elasticity and versatility.*"

PHYSICAL TRAINING NECESSARY FOR DEVELOPMENT OF HEALTH AND FACULTY OF THE BRAIN.

If we once admit, as we must, that thought and feeling, judgment and volition, are inexpressible and ineffectual except through motor acts, and that motor acts are animated and controlled by the central nervous system, the inference is clear that physical training is an essential element in the development of mental health and power. Since motor acts, like mental acts, vary greatly in their nature and effects, equal educational value is no more to be ascribed to all forms of physical training than to all forms of mental training. This is tacitly recognized in practical life. Thus the technique of the ploughman or the wood-chopper is more readily acquired and commands a lower wage than that of the violinist or the surgeon, — just as the habitual mental operations of the book-keeper are of a lower order and less highly prized than those of the engineer or the astronomer. The principles of physical training are applicable throughout a wide and varied field, since those who aim at intellectual pursuits, no less than those who are destined to become day-laborers or mechanics, stand in need of physical training of a general nature, to the end that they may have vigorous health and serviceable muscular powers; and both classes also require instruction and practice in such forms of

technical motor drill as pertain to their several callings. Broadly speaking, though the various general and special forms of physical education may differ much in respect to the manner in which certain customary forms of procedure are combined and accentuated, still the leading principles of physical training are essentially the same in kind in all its branches. If teachers of reading and of foreign tongues, as well as those of writing, drawing, and of manual training, were more apt at recognizing and turning to account the principles of physical training which are demonstrably applicable in their respective subjects, there would be less insensitiveness and indifference, both among the leaders and the rank and file of the educational armies of the United States, to the just claims of gymnastic and athletic forms of physical education to a dignified and influential place in the scientific order of our times.

STUTTERING A MOTOR DISORDER DUE TO FAULTY METHODS OF TRAINING.

Stuttering is a functional disturbance of the central nervous system, characterized by involuntary, disorderly spasms in certain muscles concerned in vocal utterance. It is frequently described as a school-disease, inasmuch as it is most prevalent among persons of school-age, and is largely due to faulty or misguided methods of instruction in speaking and reading. Experience shows that the most efficacious means both for its prevention and cure are found in the intelligent use of certain general and special forms of muscular exercise in combination. Therefore I have made a special study of the prevalence of stuttering among the pupils of our public schools, since stuttering affords striking evidence of the mischief which may arise at the very threshold of common-school education through the failure of teachers to apprehend the doctrine of muscular exercise which I have endeavored to set forth in this report.

NATURE OF NORMAL SPEECH.

Audible speech is a tissue of sound-waves in which musical sounds serve for woof and unmusical noises for warp. The raw material out of which our speech is wrought is found in the bellows-blast of air which is driven from the lungs, during the expiratory phase of respiration, through the slit of the glottis, whose membranous edges, the vocal cords, are thrown into vibration. The vibrations of the vocal cords derive their character from the action of the laryngeal muscles, and being communicated to the tide of laryngeal air give rise to the sound we call voice. As the stream of vocalized air continues its upward and outward course, through the tubular passage which leads from the larynx to the lips, it becomes subjected to a series of interruptions and resonations brought about by the muscles of articulation. Thus certain laryngeal sounds are intensified, and certain noises termed vowels and consonants are added to or superposed on them, and articulate speech is the result. The production of articulate speech, then, consists of a highly complicated series of movements, in which three sets of coördinated movements — which are effectuated by muscles seated in the chest, the throat, and the mouth respectively — are coördinated into a single act.

DIFFERENT ORDERS OF MOVEMENT INVOLVED IN SPEECH.

Mercier's characterization of the movements involved in speech is in point here. "In vocal utterance," he says, "there are three sets of movements, those of breathing, those of phonation, and those of articulation. Breathing is effected mainly by the most central of all muscles, and its movements occur in simplest succession and in brief and simple rhythm. Voice is produced mainly by movements of the larynx — movements that are midway between the central movements of breathing and the peripheral move-

ments of articulation, and the sequence of these movements is intermediate between those of breathing and those of articulation. . . . Now advance to the extreme periphery and take the movements of articulation. Each spoken word, like each written word, requires for its formation several movements succeeding each other in definite order, at definite intervals; and each sentence is a long sequence made up of many such short sequences arranged in a definite order. The number of different movements of the articulatory apparatus that go to make up even a short speech is therefore enormous, and these movements and sequences of movement occur rarely, and at intervals that are extremely irregular." To this we may add that the neuro-muscular mechanisms of breathing are fundamental, while those concerned in phonation and articulation are relatively accessory, the latter being particularly so.

It is hardly necessary to show, though it may well be stated, by way of reminder, that of the three orders of movement, mentioned above, articulatory movements are not only more numerous, varied, and arhythmical than those of voice and breathing, but are also more precisely limited, more highly specialized, more artificial, more easily disturbed and marred, and require more careful, prolonged, and intelligent training to secure their full development. It is important, also, to remember that the nerve-centres which represent the three different orders of movement pertaining to speech-production are found in different levels of the cerebro-spinal system, and become organized and fully capable at different periods in the evolution of the organ of mind.

KUSSMAUL'S THREE STAGES OF SPEECH-DEVELOPMENT IN THE CHILD.

The leading work on the pathology of speech is "Die Störungen der Sprache von Dr. Adolf Kussmaul, Professor

in Strassburg." Kussmaul, like the late Charles Kingsley, was once a stutterer. In the extracts from Kussmaul which follow, I quote from the third edition of his work published in 1885: "Since articulation is learned and consists of practised, coördinated movements, we must needs consider how we acquire it. We may distinguish three developmental periods here:

"(1.) Children, even before the close of the first three months of life, at about the time they begin to make grasping movements, when in a cheerful mood, are wont to indulge in various sounds, of themselves. This "babble of the suckling" consists chiefly of lip-sounds and vowels, though it includes linguals and palatals also. They are partly the familiar sounds of our alphabet, though not in their later hard and fast form, and partly strange sputtering, hissing, snarling, clucking sounds that are difficult or impossible to represent by our letters; something like pf, pfi, fbu, tl, dsi, qr, etc. They are joined together only in a loose and accidental fashion. The second class of sounds, which I will call *wild sounds*, are of a purely reflex nature. They are a product of the same impulse to muscular action which prompts the child to strike with the hands and to kick with the legs as an exercise preparatory to grasping and walking.

"One may look on them as the primitive sounds, given to men in the beginning, out of which all the sounds which our alphabet of to-day contains have been formed.

"(2.) Later, when the child hearkens and is learning to distinguish sounds, at the time when it is learning to seize objects with its hands and to use its legs in creeping and walking, and when the impulse to imitation breaks out with all its aboriginal might, — these wild sounds become gradually supplanted by the ordinary sounds of the mother tongue. There is a close correspondence between the early awakening of the musical sense and the fact that the child correctly catches and repeats vowels and diphthongs before it can re-

peat consonants in words that it hears. Its imitative power does not keep pace with its understanding of words. The child understands some words without being able to imitate them, and imitates many without being able to understand them. The great difference between understanding and perception on the one hand, and articulation on the other, appears in a striking way at the very beginning of speech-development.

" Still these first, firmly articulated sounds and syllables are of the simpler sort. With a, aa, ho, u, da, etc., the child expresses its contentment, wonder, dislike, etc. These are purely sensory reflexes, or interjections. The imitative sounds are the familiar baba, bebe, dada, dodo, atta, etc., which nurses practise with their charges. At first the child does not connect any determinate intuition with mama and papa; the spoken word is imitated only as an auditory image, and children only slightly apprehend the meaning which the women attribute to it.

" Among children, the time varies greatly at which pleasure in imitating sounds awakens, and their aptitude for imitation varies quite as much. At first the words of the imitative child bears only a distant resemblance to the words it hears, and are intelligible, for the most part, only to its familiars; but this improves with increasing rapidity. Very clever children sometimes attain considerable facility before the close of the first year. Others first show pleasure in articulate speech in the second half of the second year, or later, and make very slow progress.

" (3.) The child learns, in the third stage of its development, to associate definite images of objects with familiar words, which are gradually changed into ideal conceptions. Now, for the first time, speech becomes an expression of thought — interjections and onomatopoeia pass over into true diction. Ofttimes not until after long use of a word does its meaning flash, as it were, in an instant upon the

child, and the marvellous fusion of idea and word takes place, and the beginning of ideal speech is effected."

THE PATHOLOGY OF STUTTERING.

"Stuttering is a spastic neurosis of coördination, which hinders the utterance of syllables by convulsive contractions — at the stop points for vowels or consonants in the articulation-tube, which may occur either at the beginning or in the course of hitherto unimpeded utterance. The articulation of each individual sound is correctly performed. The disorder does not consist in difficult articulation of letters but of syllables. In the connection of consonants, particularly of explosives with succeeding vowels, more rarely in pronouncing syllables that begin with a vowel, speech becomes obstructed, and the initial sound of the syllable or the last sound of the preceding syllable is repeated, usually many times, till the impediment is overcome and the person can go on with his utterance. This spasmodic inhibition is not noticeable at all times; the stutterer has periods of speaking without difficulty."

"If we examine more closely the condition that, in stuttering, prevents the proper joining of syllables, we find that the three forms of muscular action concerned, viz., the expiratory, vocalic, and consonantal, are not coördinated. The regulating mechanism of the nerve-centres which bring about the harmonious interplay of these muscles in attuning the sounds which make up the syllables, or as Merkel puts it, in vocalizing the sounds, are thrown into disorder by insignificant peripheral excitations, and still more frequently by excitations of central origin. The three muscular actions mentioned above, which coöperate in the articulation of every syllable, are not coördinated either as to the force or the duration of their contractions; consequently the stream of air requisite for speech is deficient in tension sufficient to overcome the opposing tension of the vocalic and conso-

nantal muscles. On the one hand, the action of the breathing muscles concerned in speech is at fault, and on the other, the action of the vocalic and consonantal muscles is convulsive. The contractions of these muscles, instead of proceeding quietly at normal intervals, take on the form of tonic or clonic spasms."

DISTINCTION BETWEEN STUTTERING AND STAMMERING.

"It was not till the third decade of the present century that the distinction between stammering and stuttering was sharply drawn. Schulthess, a Swiss, deserves the chief credit for it. Stammering is sometimes a congenital and sometimes an acquired defect; sometimes it is functional only, being due to bad training and insufficient exercise; sometimes it is of an organic nature. The organic cause for it in some cases lies in the central nervous system or in the motor nerves of speech; in others in the peripheral organs of articulation, the tongue, palate, etc."

German and French writers recognize and emphasize the distinction above noted. English writers for the most part ignore it, or are loth to admit it. Dr. H. Gutzmann, of Berlin, whose "Vorlesungen über die Störungen der Sprache und ihre Heilung. Berlin, 1893," easily holds first place among recent works on speech-disorders, says, "In stuttering we have to do, as we have seen, with muscle-spasms which constitute a hindrance to fluent speech; while the stammerer speaks fluently and without any trace whatever of involuntary muscular movements. Among stutterers simultaneous by-movements always present themselves, but never among stammerers. Stuttering is a failure in speech, stammering a failure in pronunciation."

Stuttering, then, involves a lack of coördination in the neuro-muscular mechanisms concerned in vocal utterance. Dr. Marshall Hall considered it to be "a partial chorea,"

and we may for general purposes characterize stuttering as a St. Vitus' dance of the finer, more peripheral muscles of speech.

THE BREATHING MUSCLES USUALLY AT FAULT IN STUTTERING.

Though any one or all of the series of organs concerned in producing speech may be affected in one who stutters, the respiratory muscles are almost certain to be at fault. "Stutterers always lack," says Kussmaul, "that control of the breath which is requisite for speech. They inhale too little air for their purposes, are not sufficiently economical of it, allow it to escape unused, and sometimes are obliged to draw breath in the middle of a word." Experience has shown abundantly that, unless the central breathing muscles are first set right, efforts directed toward restoring the coordinated action of the throat and mouth muscles are largely wasted. It is a most significant fact that those who are most successful in the treatment of stuttering have instinctively, if not wittingly, taken the law of the evolution of the nervous system as their guide. As a rule, they begin their efforts with gymnastic exercises of the breathing muscles, and later on direct their attention to developing normal habits of action, first in the muscles of phonation and then in those of articulation. In other words, their training of the accessory neuro-muscular mechanisms is based on the preliminary development of the fundamental and intermediate mechanisms of the series. What is this but the application of the principles of physical training?

STUTTERING A NEUROSIS OF DEVELOPMENT.

Though stuttering is aggravated by conditions which heighten the susceptibility of the nervous system to disturbing influences, such as occur during the period of second dentition and the onset of puberty, it does not follow that

stutterers, as a rule, are weak and sickly persons. Indeed very many, if not most stutterers, are the victims of bad example and neglect rather than of poor health. Clouston in his "Neuroses of Development" assigns stuttering and backwardness in speech a prominent place among the neuroses especially liable to occur in what he denominates "the period of most rapid brain-growth, of special sense education, and of the development of the leading motor coördinations," viz., the period from birth to seven years of age. It is during this very period that most children enter school, and are launched upon intellectual pursuits by being taught the rudiments of the art of reading aloud. To read aloud correctly, the reader must be able to do two things: firstly, to recognize and associate the letters which are arbitrarily used as symbols of significant sounds; and secondly, he must be able to reproduce correctly and clearly the sounds symbolized by the printed or written characters. The first step involves a mental act; the second step is more largely a motor act; but, so long as it remains a novel or habitual act, it calls for a considerable degree of attention or mental effort. If the learner's perception of sounds be dull, if its powers of utterance be undeveloped or defective — unless the teacher be an unusually acute or watchful person — it is a comparatively easy matter to induce stammering or stuttering among Abecedarians.

H. Gutzmann declares that fully one-half of the children who enter school [in Prussia?] are not fully developed as to their powers of vocal utterance.

Given a shy, sensitive, or backward child and an overworked, breathless, nagging teacher, and mental dulness or hesitancy may readily be driven to express itself in halting or disordered speech; infantile inability to utter certain sounds correctly may pass into confirmed stammering; or disordered, convulsive action in one or more of the speech-producing mechanisms become the fixed habit of stuttering.

Once let a class become infected, and the contagious influence of bad example may contribute powerfully to the spread of stammering and stuttering among school-children. To my mind it is quite as needful for the teacher of reading to apply the principles of physical training to the prevention of stuttering as for the vocal trainer to apply those principles in curing it. The training of the vocal organs involves so much exercise which is essentially of a gymnastic nature, as to lead me to hold that if the motor education of the younger children in our schools were properly organized in the departments of free play and gymnastics, a considerable amount of stuttering might be prevented. But so long as teachers in the kindergarten and the primary schools are not taught and obliged to follow the most natural and rational methods of teaching speech and reading, the schools are likely to deserve the appellation of "nurseries of stuttering" which has been bestowed upon them by A. Melville Bell, the well-known inventor of visible speech.

"SCHOOLS THE NURSERIES OF STUTTERING."

Professor Bell's eminence as a student of phonetics, and his long experience as a teacher, entitle his opinion in this connection to great weight. So long ago as 1866 he wrote as follows: "No part of education is, in general, so lightly esteemed as that of first learning to speak and read; yet, rightly considered, none is of more consequence. First impressions are the deepest and strongest, and the lessons of the Abecedarian are the most abiding. The first governess, tutor, or school-master, should be a model of distinctness in his own practice, and should be, also, intimately acquainted with the physiology of articulation, that he may, both by wise precept and potent example, mould the plastic mouth to grace, and give easy play to the delicate machinery of speech. *With a proper initiatory training, and school surveillance, stammering, and its train of silent sorrows, would be altogether unknown.*"

There is a voluminous literature on stuttering and stammering; but much of it, owing to the prevalence of "stutter-doctors" and fanatical elocutionists, is unscientific and worthless. The subject has not received, hitherto, the attention which it deserves from the teaching class, or those to whom teachers look for inspiration and guidance. Strange to say, our educational literature, so far as I am able to learn by inquiry and search, does not contain a comprehensive and satisfactory study of the psycho-physics of reading aloud. Yet psychology is the shibboleth and war-cry of our normal schools!

GERMAN EXPERIENCE IN ABATING STUTTERING IN SCHOOLS.

Within the last ten years, however, educational authorities in Germany, the Prussians being in the lead as usual, have begun to attack the stuttering habit in its breeding-ground, *i.e.*, in the elementary schools, by forming special classes for stutterers under public-school teachers who have received special training in the physiological method of securing normal utterance. The movement grew out of the teachings and writings of A. Gutzmann, an accomplished and successful teacher in the City School for Deaf Mutes, in Berlin. In 1886, a Potsdam teacher, who had attended Gutzmann's courses of instruction, was placed in charge, by the Potsdam school authorities, of an experimental class made up of twelve stutterers. After about three months' instruction, nine of the class were able to speak and read quite fluently and normally. So a second class was formed in 1887. In 1887 investigation showed that 1.22 per cent. of the children in the Folk-schools of Elberfeld were stutterers. Two teachers were sent to Berlin to familiarize themselves with Gutzmann's method, and on their return were placed in charge of two classes of stuttering school-children. In 1889, Dr. von Gossler, the Prussian Minister of Education, issued a circular calling the attention of the Inspectors

of Schools throughout the kingdom to the success of the Potsdam and Elberfeld experiments, and recommending the formation of similar classes wherever a considerable number of stutterers should be found in the schools. Since 1889 such classes have become quite common in other parts of Germany, as well as Prussia. Those who wish for detailed information regarding this movement in Germany will do well to consult Gutzmann's "Medizinisch-pädagogische Monatsschrift für die gesammte Sprachheilkunde," now in its fourth volume. The December number, 1891, contains a list of 190 persons, — 180 teachers and 10 physicians, — who had taken Gutzmann's normal course; and mentions no less than 32 towns and cities in which school-courses for stuttering children had been held up to that time. In the same journal for 1892, I find reports of such courses, held mostly in 1891–92, in 15 different places, and note that of 344 stutterers and stammerers under instruction, 272 were reported cured, 58 improved, and 14 unimproved. The "Monatsschrift," for May, 1894, contains a report of eight school courses for stutterers in the schools of Spandau, near Berlin, held at intervals from July, 1890, to March, 1894. On the average, each class contained 8 pupils and lasted 4 months. Of 64 children, 52 overcame the stuttering habit, 8 were decidedly improved, 2 showed no marked improvement, and 2 withdrew from the class so early as to be left out of the account; 40 of the 64 were still in school, though not in the special class for stutterers, in March of the present year. Again, the report on the results of the instruction given to 261 stutterers in Dresden schools, during 1889–1893, yields the following result: cured, 49.6 per cent.; decidedly improved, 31.3 per cent.; slightly improved, 9.9 per cent.; without results, 0.76 per cent.

RELATIVE FREQUENCY OF STUTTERING IN EUROPE AND THE UNITED STATES.

The amount of stuttering varies in different countries to such an extent that nationality is held by some writers to exercise an influence in producing the disorder. Though it does not appear that the ratio of stutterers to the whole population has been determined accurately in any country, the number of recruits and conscripts exempted from military service, at various times, in France, Russia, and the United States, afford an inkling as to the prevalence of stuttering among young men in each of these countries. Summarily stated, the ratio of the number of men exempted on account of stuttering, to the number of conscripts subjected to particular examination touching their habits of utterance, was 6.33 per 1,000 in France, in the period 1850–1869; 1.36 per 1,000 among natives of the United States, during the War of Secession; and 1.20 per 1,000 in Russia, in the period 1876–1882. The above figures are derived, in the order given, from Chervin's "Statistique de Bégaiement en France, Paris, 1878," Baxter's "Statistics, Medical and Anthropological, of the Provost-Marshal-General's Bureau, Washington, 1875," and Ssikorski's "Ueber das Stottern, Berlin, 1891."

It is evident, however, from certain admissions of Chervin's, that had he given the ratio of men exempted for stuttering to all conscripts examined touching their fitness for military service, the result would be about 3.25 per 1,000, instead of 6.33. On this basis the figures for natives of the United States would be 1.227 per 1,000. Dr. Baxter's statistics show that of 3,243 Frenchmen offering as recruits in the United States army, during the late war, 3.08 per 1,000 were rejected on account of stuttering. Ssikorski does not furnish data for reducing his figures to the standard used in this paragraph.

It is clear, so far as we have data on which to form an opinion, that stuttering is more frequent among children of school age than among young men of military age. Thus Ssikorski's statistics of 22.878 Russian school-children show that 1.57 per cent. were stutterers. I am unable to cite any statement as to the prevalence of stuttering in French schools. In Germany this question has received a good deal of attention, as is evident from the following table:

TABLE SHOWING FREQUENCY OF STUTTERING AMONG SCHOOL-CHILDREN IN CERTAIN CITIES IN GERMANY.

Date of Report.	Place.	Number examined.	Number of Stutterers.	Per cent. of Stutterers.
1886	Berlin	155,000	1,550	1.00
1886	Breslau	37,000	355	0.93
1886	Dresden	27,000	442	1.63
1887	Elberfeld	18,000	220	1.22
1891	Wiesbaden	9,312	134	1.40
1890	Altendorf	6,000	141	2.35
		252,312	2,842	1.12

STUTTERING AMONG BOSTON SCHOOL-CHILDREN.

It would be hazardous even to attempt to guess at the proportion of stutterers to be found among American school-children, since American educationists, hitherto, have shown no disposition worth mentioning to meddle with the question of stuttering in any of its aspects. It is safe to say, however, that out of every thousand children in the public schools of Boston at least *seven* stutter or stammer. This statement is based on the results of two censuses of stutterers which I have had made during the last twelve months.

With the approval and consent of the Chairman of the Committee on Hygiene and Physical Training the

Principals of Schools have been asked twice during 1893–94 to report to me the names of all habitual stutterers in their schools, first on May 1, 1893, and again on January 31, 1894. In addition to the name, the age and class in school of each stutterer was asked for, together with a characterization of his malady as "slight" or "severe," as the case might be. The first census disclosed the presence of 500 stutterers, or 0.78 per cent. of all pupils in the day schools; the second census contained the names of 498, or 0.75 per cent. The total number of pupils belonging to the day schools on January 31, 1893, and on January 31, 1894, amounts to 129,060; the sum of the stutterers found in the two enumerations was 998, or 0.77 per cent. I found it inexpedient to attempt to discriminate in the returns by the teachers between stammerers and stutterers. Detailed results of the returns are found in the appended tables.

TABLE VII.

SHOWING THE NUMBER AND PERCENTAGE OF STUTTERERS, BY AGE AND SEX, IN THE BOSTON PUBLIC SCHOOLS, MAY 1, 1893.

Age.	Number of Pupils.		Stutterers.				Totals.		
	Boys.	Girls.	Boys.	Per cent.	Girls.	Per cent.	Pupils.	Stutterers.	Per cent.
1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
Under 4.	125	126	....	....	....	....	251	....	....
4–5 . . .	581	603	4	0.68	2	0.33	1,184	[illegible]	0.50
5–6 . . .	1,987	1,708	11	0.55	1	0.05	3,695	12	0.32
6–7 . . .	2,857	2,575	33	1.15	11	0.42	5,432	44	0.81
7–8 . . .	3,141	2,830	35	1.11	17	0.60	5,971	52	0.87
8–9 . . .	3,222	2,862	45	**1.39**	15	0.52	6,084	60	**0.98**
9–10 . . .	3,164	2,865	36	1.13	8	0.27	6,029	44	0.72
10–11 . .	3,316	2,935	34	1.02	14	0.47	6,251	48	0.76
11–12 . .	3,061	2,771	27	0.88	11	0.39	5,832	38	0.65
12–13 . .	3,231	2,935	34	1.05	17	**0.59**	6,166	51	0.82
13–14 . .	3,057	2,604	42	**1.37**	11	0.42	5,661	53	0.93
14–15 . .	2,439	2,075	29	1.18	10	0.48	4,514	39	0.86
15–16 . .	1,545	1,567	19	1.22	6	0.38	3,112	25	0.80
16–17 . .	783	894	13	**1.66**	5	**0.55**	1,677	18	**1.07**
17–18 . .	396	529	3	0.75	....	....	925	[illegible]	0.32
18–19 . .	147	253	2	1.36	1	0.39	400	3	0.75
19+ . .	51	239	4	7.84	....	....	290	4	**1.37**
	33,103	30,371	371 or 1.12%		129 or 0.42%		63,474	500 or 0.78%	

The above table shows the distribution by sex and age of the habitual stutterers, reported by their teachers as belonging to the Boston public schools on May 1, 1893. In calculating the percentage of stutterers, I was obliged to make use of the figures given in columns 2, 3, and 8, which stand for the number of pupils, at each age, belonging to the schools on January 31, 1893, as corresponding data for May 1, 1893, could not be had conveniently. It would appear that the per cent. of stutterers in the Boston public schools, viz., 0.78, is less than that reported for the group of German public schools noted above, which is 1.12 per cent. The percentage figures printed in full-faced type should be particularly noted, since it would appear from Table VII. that the greatest incidence of stuttering is not relatively similar for boys and girls of a given age. That 1.12 per cent. of all boys and only 0.42 per cent. of all girls belonging to the schools should stutter is not surprising, since it has frequently been noted, by European observers, that from three to four times as many boys as girls stutter habitually. The table also shows, what has been noted frequently, that stuttering is particularly frequent at the period of second dentition, and at the onset of puberty, which are periods when the nervous system appears to be especially susceptible to disturbance.

TABLE VIII.

SHOWING THE NUMBER AND PERCENTAGE OF STUTTERERS, BY AGE AND SEX, IN THE BOSTON PUBLIC SCHOOLS, JANUARY 31, 1894.

Age.	Number of Pupils.		Stutterers.				Totals.		
	Boys.	Girls.	Boys.	Per cent.	Girls.	Per cent.	Pupils.	Stutterers.	Per cent.
1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
Under 4.	137	180	. . . .	. . . .	. . . .	. . . .	317	. . . .	. . . .
4–5 . . .	636	589	[illegible]	0.31	1	0.16	1,225	3	0.24
5–6 . . .	2,202	1,896	19	0.86	[illegible]	0.31	4,098	25	0.61
6–7 . . .	3,150	2,671	34	1.07	3	0.11	5,821	37	0.63
7–8 . . .	3,178	2,955	26	0.81	11	0.37	6,133	37	0.60
8–9 . . .	3,280	2,969	39	1.18	14	0.47	6,249	53	0.84
9–10 . .	3,204	2,874	32	0.99	14	0.48	6,078	46	0.75
10–11 . .	3,199	2,911	41	1.28	8	0.37	6,110	9	0.80
11–12 . .	3,147	2,832	36	1.14	8	0.28	5,979	44	0.73
12–13 . .	3,227	2,863	41	1.27	15	0.52	6,090	56	0.91
13–14 . .	3,180	2,842	38	1.19	10	0.35	6,022	48	0.79
14–15 . .	2,543	2,161	29	1.14	16	0.74	4.704	45	0.93
15–16 . .	1,572	1,547	20	1.26	[illegible]	0.38	3,119	26	0.83
16–17 . .	884	1,004	15	1.69	3	0.29	1,888	18	0.95
17–18 . .	466	512	3	0.64	2	0.39	978	5	0.51
18–19 . .	215	297	1	0.46	1	0.34	512	2	0.39
19+ . .	70	293	[illegible]	4.28	1	0.34	363	4	1.10
	34,290	31,396	379 or 1.10%		119 or 0.37%		65,686	498 or 0.75%	

Table VIII. gives an analysis of the results of the enumeration of stutterers found in the schools on January 31, 1894. The per cents of stutterers range slightly lower than in Table VII. It is possible that there is more stuttering in the spring than in the winter.

TABLE IX.

SHOWING THE NUMBER AND PERCENTAGE, BY AGE AND SEX, OF STUTTERERS IN THE BOSTON PUBLIC SCHOOLS, ON MAY 1, 1893, AND JANUARY 31, 1894, TAKEN TOGETHER.

Age.	Number of Pupils.		Stutterers.				Totals.		
	Boys.	Girls.	Boys.	Per cent.	Girls.	Per cent.	Pupils.	Stutterers.	Per cent.
1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
Under 4 .	262	306	. . . .	. . . .	. . . .	. . . .	568	. . . .	. . . .
4–5 . . .	1,217	1,192	6	0.49	3	0.25	2,409	9	0.37
5–6 . . .	4,189	3,604	30	0.71	7	0.11	7,793	37	0.47
6–7 . . .	6,007	5,246	67	1.11	14	0.26	11,253	81	0.71
7–8 . . .	6,319	5,785	61	0.95	28	**0.48**	12,104	89	0.73
8–9 . . .	6,502	5,831	84	**1.29**	29	**0.49**	12,333	113	**0.91**
9–10 . . .	6,368	5,739	68	1.06	22	0.38	12,107	90	0.74
10–11 . .	6,515	5,846	75	1.14	22	0.37	12,361	97	0.78
11–12 . .	6,208	5,603	63	1.01	19	0.33	11,811	82	0.69
12–13 . .	6,458	5,798	75	1.16	32	**0.55**	12,256	107	**0.87**
13–14 . .	6,237	5,446	80	**1.28**	21	0.38	11,683	101	0.86
14–15 . .	4,982	5,236	58	1.16	26	0.49	9,218	84	**0.91**
15–16 . .	3,117	3,114	39	1.24	12	0.38	6,231	51	0.81
16–17 . .	1,667	1,898	28	**1.61**	8	**0.42**	3,565	36	1.00
17–18 . .	862	1,041	6	0.69	2	0.19	1,903	8	0.42
18–19 . .	362	550	3	0.82	2	0.36	912	5	0.54
19	121	532	7	5.78	1	0.18	653	8	1.22
	67,393	61,767	750 or 1.11%		248 or 0.40%		129,160	998 or 0.77%	

In Table IX. the data of Tables VII. and VIII. are consolidated. Tables VII. and IX. agree in showing that girls of *seven*, *twelve*, and *sixteen* years of age are particularly subject to the disorder of stuttering, and that the corresponding ages for boys are *eight*, *thirteen*, and *sixteen*. If, as has already been suggested, the growth-rates of brain and body, and specific intensity of life, differ for boys and girls of the same age, it may prove true, on further investigation, that boys and girls of the same age differ from each other in their susceptibility, not only to stuttering, but to other forms of nervous disorder.

TABLE X.

SHOWING THE NUMBER AND PERCENTAGE OF STUTTERERS BY SEX, CLASS, AND GRADE IN THE BOSTON PUBLIC SCHOOLS, A, IN 1893, B, IN 1894, AND C IN 1893 AND 1894 TAKEN TOGETHER.

Year.			Kindergarten.		Primary Grade.				Grammar Grade.								High School Grade.		Total for all Grades.
				Total.	Cl. III.	Cl. II.	Cl. I.	Total.	Ungraded Class.	Cl. VI.	Cl. V.	Cl. IV.	Cl. III.	Cl. II.	Cl. I.	Total.	All Classes.	Total.	
1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	17.	18.	19.	20.
A. 1893.	Pupils.	Boys . .	1,135	1,135	5,895	4,295	3,491	13,681	1,037	3,492	3,468	2,939	2,444	1,887	1,282	16,549	1,738	1,738	33,103
		Girls . .	1,188	1,188	5,135	3,820	3,134	12,089	576	3,185	3,229	2,801	2,317	1,901	1,248	15,257	1,837	1,837	30,371
	Stutterers.	Boys . .	11	11	66	55	40	161	8	43	34	31	24	18	16	174	25	25	371 1.12%
		Per cent.	0.96	0.96	1.12	1.28	1.14	1.17	0.77	1.23	0.98	1.05	0.98	0.95	1.24	1.05	1.43	1.43	
		Girls . .	2	2	29	18	11	58	0	10	20	13	14	7	2	66	3	3	129 0.42%
		Per cent.	0.17	0.17	0.56	0.47	0.34	0.47	0.00	0.31	0.61	0.45	0.60	0.36	0.16	0.43	0.16	0.16	
	Totals.	Pupils .	2,323	2,323	11,030	8,115	6,625	25,770	1,613	6,677	6,697	5,740	4,761	3,788	2,530	31.806	3,575	3,575	63,474
		Stutterers	13	13	95	73	51	219	8	53	54	44	38	25	18	240	28	28	500 0.78%
		Per cent.	0.55	0.55	0.86	0.89	0.75	0.84	0.49	0.79	0.86	0.76	0.79	0.65	0.70	0.75	0.78	0.78	

B. 1894.	Pupils.	Boys . .	1,247	1,247	6,269	4,324	3,560	14,153	966	3,670	3,454	3,199	2,508	1,877	1,301	16 975	1,915	1,915	34,290	
		Girls . .	1,271	1,271	5,286	3,717	3,367	12,370	6.24	3,251	3,197	3,003	2,330	1,951	1,448	15,804	1,951	1,951	31,396	
	Stutterers.	Boys . .	6	6	63	49	42	154	14	45	41	26	32	25	17	200	19	19	379	1.10%
		Per cent.	0.64	0.64	1.00	1.13	1.17	1.08	1.45	1.22	1.18	0.81	1.27	1.32	1.30	1.17	0.99	0.99		
		Girls . .	1	1	17	17	20	54	0	7	9	12	15	10	5	58	6	6	119	0.37%
		Per cent.	0.08	0.08	0.32	0.45	0.59	0.43	0.00	0.21	0.28	0.39	0.64	0.51	0.34	0.36	0.30	0.30		
	Totals.	Pupils .	2,518	2,518	11,555	8,041	6,927	26,523	1,590	6,921	6,651	6,202	4,838	3,828	2,749	32,779	3,866	3,866	65,686	
		Stutterers	7	7	80	66	62	208	14	52	50	38	47	35	22	258	25	25	498	0 75%
		Per cent.	0.27	0.27	0.79	0.82	0.89	0.76	0.88	0.74	0.75	0.61	0.97	0.91	0.80	0.78	0.64	0.64		
C. 1893 and 1894.	Pupils.	Boys . .	2,382	2,382	12,164	8,619	7,051	27,834	2,003	7,162	6,922	6,138	4,952	3,764	2,583	33,524	3,653	3,653	67,393	
		Girls . .	2,459	2,459	10,421	7,537	6,501	24,459	1,200	6,436	6,426	5,804	4,647	3,852	2,696	31,061	3,788	3,788	61,767	
	Stutterers.	Boys . .	17	17	129	104	82	315	22	88	75	57	56	43	33	374	44	44	750	1.11%
		Per cent.	0.71	0.71	1.06	1.20	1.16	1.13	1.09	1.22	1.08	0.92	1.11	1.14	1.27	1.11	1.20	1.20		
		Girls . .	3	3	46	35	31	112	. . .	17	29	25	29	17	7	124	9	9	248	0.40%
		Per cent.	0.11	0.11	0.44	0.47	0.47	0.46	. . .	0.26	0.45	0.43	0.62	0.44	0.26	0.39	0.30	0.30		
	Totals.	Pupils .	4,841	4,841	22,585	16,156	13,552	52,293	3,203	13,598	13,348	11,942	9,599	7,616	5,279	64,585	7,441	7,441	129,160	
		Stutterers	20	20	175	139	113	427	22	105	104	82	85	60	40	498	53	53	998	0.77%
		Per cent.	0.41	0.41	0.77	0.86	0.83	0.81	0.68	0.77	0.77	0.68	0.88	0.78	0.75	0.77	0.71	0.71		

The foregoing table is constructed to show the percentage-distribution of all stutterers, and of the stutterers of each sex, in the several school grades. The high per cent. of stutterers in the primary schools, and the marked increase of stuttering among pupils of the primary schools, as compared with pupils in the kindergartens, is strikingly brought out in this table. *It seems to me to be a highly significant fact that the amount of stuttering, both in boys and girls, is greatly augmented at the very time when instruction in reading aloud is begun. In view of this fact the query naturally suggests itself: how far are kindergarten and primary school methods of language-training responsible for the prevalence of stuttering among our younger school-children?*

CONCERNING THE NUMBER OF SLIGHT AND SEVERE STUTTERERS.

The total number of stutterers enumerated by the teachers in the two censuses under consideration was 998. In the case of 639, or 64.02 per cent., the malady was characterized as "slight," while 359 cases, or 35.96 per cent., were characterized by the term "severe." In both categories not far from three times as many boys' as girls' names are found. Table XI., given below, shows that among 639 slight stutterers, 481, or 48.19 per cent., were boys, and 158, or 15.83 per cent., were girls; and that of 359 severe stutterers, 269, or 26.95 per cent., were boys, and 90, or 90.01 per cent., were girls. Inspection of Table XI., which is constructed to show the percentage-distribution, by age, of slight stutterers, severe stutterers, and of all stutterers, shows that slight stuttering is most frequent between 7 and 10 years of age (see columns 2, 3, and 4), and that severe stuttering is most frequent between the ages 11 and 14. This would indicate that the susceptibility to stuttering, which is intensified at the beginning of the second dentition and at the onset of puberty, is greater at the latter period.

TABLE XI.

SHOWING THE PERCENTAGE-DISTRIBUTION, BY AGE AND SEX, OF SLIGHT STUTTERERS, SEVERE STUTTERERS, AND OF ALL STUTTERERS, FOR 1893 AND 1894 TAKEN TOGETHER, IN THE BOSTON PUBLIC SCHOOLS.

	Slight Stutterers.			Severe Stutterers.			All stutterers.		
1. Age.	2. Boys.	3. Girls.	4. Boys and Girls.	5. Boys.	6. Girls.	7. Boys and Girls.	8. Boys.	9. Girls.	10. Boys and Girls.
4–5	1.04	1.89	1.25	0.37	. . . . .	0.27	0.80	1.20	0.90
5–6	5.61	1.89	4.69	1.11	4.44	1.94	3.86	2.82	3.70
6–7	11.22	6.32	10.01	4.83	4.44	4.73	8.93	5.64	8.11
7–8	9.77	12.65	10.48	5.20	8.88	6.12	8.13	11.28	8.91
8–9	11.64	14.55	12.36	10.40	6.66	9.47	11.20	11.69	11.32
9–10	8.52	8.22	8.45	10.03	10.00	10.02	9.06	8.87	9.01
10–11	10.39	6.32	9.38	9.29	13.33	10.30	10.00	8.87	9.71
11–12	8.31	9.49	8.60	8.55	4.44	7.52	8.40	7.66	8.21
12–13	8.73	13.29	9.85	12.26	12.22	12.25	10.00	12.90	10.72
13–14	8.93	7.59	8.60	13.75	10.00	12.81	10.66	8.46	10.12
14–15	8.31	9.49	8.60	6.69	12.22	8.07	7.72	10.46	8.41
15–16	3.74	3.79	3.75	7.80	6.66	7.52	5.20	4.83	5.11
16–17	2.70	1.89	2.50	5.57	5.55	5.87	3.73	3.22	3.50
17–18	0.20	0.63	0.31	1.85	1.11	1.67	0.80	0.80	0.80
18–19	0.20	1.26	0.46	0.74	. . . . .	0.55	0.40	0.80	5.01
19	0.62	0.63	0.62	1.48	. . . . .	1.11	0.90	0.40	0.80
Total	481	158	639	269	90	359	750	248	998
Per cent. of all stutterers	48.19	15.83	64.02	26.95	9.01	35.96	75.16	24.84	100.00

CORRELATION OF RATES OF STUTTERING WITH GROWTH-RATES AND SPECIFIC INTENSITY OF LIFE.

In commenting on Table VI., I called attention to the fact that Boston girls grow most rapidly during the year in which their specific intensity of life is greatest, viz., the *twelfth*, and that Boston boys grow most rapidly in their fourteenth and fifteenth years, though the *thirteenth* is the year in which their specific intensity of life is greatest. It was also noted that specific intensity of life and the rates of growth in height and weight decline sharply in both sexes after the *sixteenth* year. Since analysis of Tables VII., and IX., shows that girls of *seven*, *twelve*, and *sixteen*, and boys of *eight*, *thirteen*, and *sixteen*, are particularly given to stuttering, the question naturally arises, whether the susceptibility of the nervous system to the motor disorder of stuttering, which seems to differ in boys and girls, may not be correlated with their respective rates of growth and immunity from death. Analysis of the following table seems to point in the direction of such a correlation :

TABLE XII.

COMPILED FROM TABLES VI., IX., AND XI., SHOWING THE RELATION OF THE STUTTERING-RATES OF CHILDREN IN THE BOSTON PUBLIC SCHOOLS TO THEIR GROWTH-RATES AND SPECIFIC INTENSITY OF LIFE-RATES.

Age.	Girls. Life-rates. Specific Intensity of Life.	Girls. Height-rates. Average Yearly Increase in Centimeters.	Girls. Height-rates. Average Yearly Increase Per cent. in Centimeters.	Girls. Weight-rates. Average Yearly Increase in Kilograms.	Girls. Weight-rates. Average Yearly Increase Per cent. in Kilograms.	Girls. Stuttering-rates. Per cent. of Stutterers at Each Age.	Girls. Stuttering-rates. Percentage Distribution of Slight Stutterers by Age.	Girls. Stuttering-rates. Percentage Distribution of Severe Stutterers by Age.	Boys. Life-rates. Specific Intensity of Life.	Boys. Height-rates. Average Yearly Increase in Centimeters.	Boys. Height-rates. Average Yearly Increase per cent. in Centimeters.	Boys. Weight-rates. Average Yearly Increase in Kilograms.	Boys. Weight-rates. Average Yearly Increase per cent. in Kilograms.	Boys. Stuttering-rates. Per cent. of Stutterers at Each Age.	Boys. Stuttering-rates. Percentage Distribution of Slight Stutterers by Age.	Boys. Stuttering-rates. Percentage Distribution of Severe Stutterers by Age.	Age.
1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	17.	18.
5–6 . .	60.08	5.2	4.00	1.6	8.88	0.11	1.89	4.44	67.3	5.5	5.20	1.9	10.25	0.71	5.61	1.11	5–6
6–7 . .	69.5	5.5	4.08	1.9	9.69	0.26	6.32	4.44	74.5	5.1	4.58	1.8	8.78	1.11	11.22	4.83	6–7
7–8 . .	103.8	5.3	4.58	1.9	8.83	0.48	12.65	8.88	106.8	5.1	4.38	2.2	9.86	0.95	9.77	5.20	7–8
8–9 . .	123.2	4.5	3.72	2.5	10.68	0.49	14.55	6.66	164.0	4.9	4.03	2.4	9.79	1.29	11.64	10.40	8–9
9–10 . .	[1]195.4	[1]5.0	[1]3.98	2.4	9.26	0.38	8.22	10.00	134.8	5.1	4.04	2.8	10.40	1.06	8.52	10.03	9–10
10–11 .	[2]191.2	[2]5.3	[2]4.06	[1]2.9	[1]10.24	0.37	6.32	13.33	[1]209.3	4.1	3.12	2.2	7.43	1.14	10.39	9.29	10–11
11–12 .	[3]309.0	[3]6.2	[3]4.56	[2]4.3	[2]13.78	0.33	9.49	4.44	[2]233.2	[1]4.6	[1]3.39	[1]3.1	[1]9.74	1.01	8.31	8.55	11–12
12–13 .	[4]232.0	[4]5.8	[4]4.08	[3]4.7	[3]13.23	0.55	13.29	12.22	[3]290.1	[2]5.3	[2]3.78	[2]3.6	[2]10 31	1.16	8.73	12.26	12–13
13–14 .	162.0	[5]4.6	3.11	[4]4.4	[4]10.94	0.38	7.59	10.00	[4]238.7	[3]6.8	[3]4.68	[3]4.5	[3]11.66	1.28	8.93	13.75	13–14
14–15 .	171.3	2.9	1.90	[5]3.5	3.14	0.49	9.49	12.22	[5]250.1	[4]6.1	[4]4.01	[4]5.6	[4]13.02	1.16	8.31	6.69	14–15
15–16 .	169.3	1.2	0.77	[6]2.7	5.61	0.38	3.79	6.66	188.1	[5]6.9	[5]4.36	[5]6.3	[5]12.96	1.24	3.74	7.80	15–16
16–17 .	152.0	0.8	0.51	1.6	7.83	0.42	1.89	5.55	151.9	2.9	1.75	[6]2.9	5.23	1.61	2.70	5.57	16–17
17–18 .	125.6	0.1	. . . .	. . . .	. . . .	0.19	0.63	1.11	155.3	1.3	0.77	2.3	3.97	0.69	0.20	1.85	17–18

The figures given above as regards the specific intensity of life are for all Boston children in the census years 1875, 1885, and 1890 taken together; growth-rates for public-school children in 1875, and stuttering-rates for public-school children in 1893 and 1894 taken together.

The above table is significant and suggestive; but it cannot be considered absolutely conclusive, since it does not take into account the earlier years of the first period of immaturity and the years 18-25. Moreover, mortality, growth, and stuttering-rates, to be strictly comparable, should be computed for the same year, or series of years, which is impossible under existing conditions.

As stuttering is a functional disorder rather than a constitutional disease, it can hardly be considered a factor in augmenting the death-rate of children or adults, though Canon Kingsley was of the opinion that stutterers, as a class, were short-lived. It has been shown that among Swedish and Danish school-children (see reports and articles by Prof. Axel Key, of Stockholm, and Dr. Axel Hertel, of Copenhagen) the percentage amount of illness, which is high at the beginning of puberty, is lowered during the period of accelerated growth, and that it increases markedly after the close of that period. Somewhat similarly the amount of stuttering among Boston school-children is augmented at the beginning of accelerated growth, just before or just after such growth culminates, and again after its cessation.

Inspection of the figures printed in full-faced type in columns 7 and 15 shows that girls stutter most at the ages of 7, 8, 12, 14, and 16; and that boys stutter most at 8, 13, 15, and 16. It is readily conceivable that the nervous system should be peculiarly irritable during the period 7–9, when the "immense growth" of the brain which signalizes the first period of immaturity is closing or has just closed; and again during the years 12–14, when the growth of the musculature has culminated or is just culminating; and again in the years 15–17, when the growth-rates are at a relatively low level and death-rates are rising.

The rates of specific intensity of life given in Table XII., are based on data for three years; the per cents. of stutter-

ing are based on data for two years; while the growth-rates are based on data for one year and have reference to a much smaller number of persons than those taken into account in computing either the specific intensity of life or the per cent. of stutterers. We might expect, therefore, that the rates which show the frequency of stuttering should correspond more closely with the rates of specific intensity of life than with the rates of growth — and so they do. The high per cent. of stutterers among girls of 7 and boys of 8 years corresponds pretty closely to a marked increase of specific intensity of life (see columns 7 and 2, and 15 and 10). The correspondence is even more striking in the case of girls of 12 and boys of 13: in each case there is a marked increase of stuttering in the year immediately following that in which specific intensity of life reaches its maximum; or, in other words, stuttering increases markedly in the year in which the body's tide of exuberant vitality begins to ebb. Again, between 16 and 17, when specific intensity of life undergoes a marked decline, and is practically the same for both sexes (being 152.0 for girls and 151.9 for boys), the per cent. of stutterers is relatively high.

The most probable interpretation of the facts set forth in the above tables seems to me to be this: that the irritability of the nervous system, of which stuttering is an expression, is correlated with the most marked upward and downward fluctuations of the power of the organism to resist death-compelling influences, which power of resistance to lethal influences is an expression of the nutritive activity of the organism during its period of greatest and most rapid growth.

If we take into account the differences shown in these pages and elsewhere to exist between boys and girls in respect to their growth and death-rates and their susceptibility to disease, it must be admitted that, during most of the years devoted to elementary and secondary education,

girls are one or two years ahead of boys of the same age both in bodily and mental development. If this be admitted, it is manifestly unnatural, impolitic, and unsafe to bind identical or equal burdens on the shoulders of boys and girls of the same age and expect them to keep pace with each other stride for stride.

SIGNIFICANCE OF THE FACTS RELATING TO STUTTERING.

I have brought forward the question of stuttering in this report for two reasons: (1) in order to illustrate the fact that the fundamental principles of all forms of neuro-muscular training are the same in kind, and (2) because the application of those principles in the most approved and successful methods of teaching reading, and of preventing and curing speech-disorders of a motor character, affords a simple and practical illustration of the educative effects of systematized muscular exercise. I am firmly persuaded that the presence of 500 stammerers and stutterers in our public schools is an unnecessary evil, because it might be prevented and may be abated by simple, well-approved, practicable measures. I shall urge the teachers, especially those in the primary schools, to pay particular attention to the "breathing-movements" which occupy a prominent place in the Swedish gymnastics taught in our schools, as by so doing they may contribute towards the prevention of in-coördination in the mechanisms concerned in speech production. But I do not suppose that any radical abatement of the number of stutterers can be looked for unless recourse be had to forms of drill which are so special and technical that they do not and ought not to constitute a part of the curriculum of any school devoted to the training of teachers of gymnastics. Vocal training is based on the principles of physical training; but gymnastics and athletics, which constitute the department of physical training properly so called, are not based on vocal training and have

never been particularly well-taught or "professed" by elocutionists, singers, actors, or "stutter doctors."

To experts the educative effects of motor exercise and drill are quite as obvious in manual training, drawing, and writing as in the case of vocal training, and the mischievous results of failure to apprehend and apply the principles of physical training in each of those branches of instruction are capable of conclusive demonstration; but the distinctively school-bred disorder of stuttering was chosen for consideration in this report, since it seemed to me to be better adapted than pen-paralysis, short-sight, or spinal curvature to my purpose of impressing upon teachers the importance of following the order of nature.

CONCERNING PHYSICAL TRAINING IN THE HIGH SCHOOLS.

Although the Primary School Committee of Boston in 1833 made it incumbent on all instructors within its jurisdiction "*to attend to the physical comfort and education of the pupils under their care;*" and although the General School Committee passed a rule in 1853, requiring the masters, ushers, and teachers in the grammar and writing schools to "*so arrange the daily course of exercises in their respective classes that every scholar shall have daily, in the forenoon and afternoon, some kind of physical or gymnastic exercises*," it was not till 1860 that any action was taken, even by way of recommendation, that can be construed as applying to the pupils of the high schools of the city in respect to physical training. On December 10, 1860, the Special Committee on the Subject of Physical Training, which had been appointed to consider Superintendent Philbrick's recommendation, that a thorough system of physical training be introduced "*into all grades*" of the public schools, reported in favor of such action. The committee further recommended: (1) the appointment of a Standing Committee on Physical Training, with authority to appoint "a suitably qualified person to

aid and instruct the teachers in the training of their pupils in physical exercises;" (2) that the system of exercises, *i.e.*, modified Ling Free Gymnastics, *be practised in all the schools* not less than 15 nor more than 30 minutes each half day. None of the recommendations of the committee was adopted for some years.

MILITARY DRILL.

Early in 1864 military drill was introduced in a tentative way, under Capt. Hobart Moore, into the Latin and English High Schools, and a few grammar schools for boys, in accordance with recommendations of a Special Committee on Military Gymnastics and Drill. The Board voted, on December 27, 1864, to form a Standing Committee on Gymnastics and Military Drill "*to enforce the regulations on this subject and to superintend this branch of instruction*," with authority to employ an instructor in vocal and physical gymnastics, and an instructor in military drill. Early in 1865 the first Standing Committee on Gymnastics and Military Drill was appointed, and Mr. Lewis B. Monroe was elected to devote two hours in each school-day to the instruction "in vocal and physical gymnastics" of pupils in the Girls' High and Normal School, the Training School, and the first class of the Bowditch School; and Capt. Hobart Moore to give instruction in military drill in the Latin and English High Schools (and for a time in the upper classes of the Eliot and Dwight Grammar Schools). In 1866 Mr. Monroe's jurisdiction was enlarged and his salary doubled. He continued to act as Director of Vocal and Physical Culture till 1870, when his title was changed to Superintendent of Vocal and Physical Culture, he being required to instruct and supervise the teachers for three months only in the year. At the end of the school year of 1871 his connection with the schools ceased. He was succeeded, in 1872, by Mr. W. J. Parkerson, for three months; and by Mr. Moses True Brown,

for three months in 1873, six months in 1874, and six months in 1875. In 1875 the office of Superintendent of Vocal and Physical Culture was abolished, and Mr. Brown was made Teacher of Vocal Culture, his instruction being confined to pupils in the High and Normal Schools.

The late General Moore served as Instructor in Military Drill continuously from 1864 till his death in April, 1894. Since 1865 instruction in military drill has been confined to high-school pupils. At present the sixth class of the Latin School has gymnastics instead of military drill. During the past year, at the request of the head-master of the Latin School, I have supervised the gymnastic instruction of the sixth class in that school.

CHANGES IN NAME OF THE COMMITTEE IN CHARGE.

The standing committee in charge of the various branches of physical training was known as the Committee on Gymnastics and Military Drill, from 1864 till 1868; and from 1868 till 1875 inclusive as the Committee on Vocal and Physical Culture and Military Drill, excepting the year 1870, when for one year the supervision of drawing was added to its duties. When the School Board was reorganized in 1876, the committee in question was dropped, and military drill was placed in charge of a Standing Committee on Military Drill. The existence of this committee was terminated by a vote of the School Board, on April 23, 1878, when the control and supervision of military drill were assigned to the Committee on High Schools, in whose hands it has since remained.

Excepting the periodical nomination of special teachers of calisthenics and vocal culture in the Girls' High and the Girls' Latin Schools, there appears to have been no supervision, actual or nominal, of either "vocal or physical culture," on the part of any special or standing committee from the reorganization of the Board in 1876 till March 12,

1889, when the matter of physical exercises was referred by the Board to the Committee on Hygiene, with full powers. In January, 1890, a Standing Committee on Physical Training was instituted by the Board, and the general supervision of physical training *in all the schools* being expressly intrusted to it. In January, 1893, the Committee on Hygiene and the Committee on Physical Training were consolidated into the present Committee on Hygiene and Physical Training, whose duties are set forth in Sect. 53 of the Rules and Regulations, 1893, as follows: "*The Committee on Hygiene and Physical Training shall have the general supervision of the instruction in hygiene and physical training in all the schools. They shall make a written report to the Board in September. The Director of Physical Training and his assistant shall perform the duties of their office under the direction of this committee.*"

CITATIONS FROM RULES AND REGULATIONS.

Judging from its Rules and Regulations the School Board of twenty-five years ago was committed to the policy of providing regular instruction in some branch of physical training for the pupils of all the high schools, as well as for all the pupils in the primary and grammar schools. The following citations from the Rules and Regulations, adopted by the School Committee in 1868, support this view:

See Chap. IV., Sect. 9, setting forth the jurisdiction and duties of the Committee on Vocal and Physical Culture; Chap. V., Sect. 2, providing for the salaries of the instructor of Vocal and Physical Culture and his assistant; Chap. IX., Sect. 21, requiring the arrangement of the programme in all schools "*so that every scholar*" should have "*each forenoon and afternoon some kind of physical exercise;*" Chap. X., Sect. 6, with regard to the "physical culture" of primary pupils; Chap. XI., Sect. 11, requiring each grammar-school teacher to devote at least twenty minutes

each day to vocal and physical exercises; Chap. XII., Sect. 10, relative to instruction in military drill, for two hours each week, in the Latin School; Chap. XIII., Sect. 12, which provides for similar instruction in military drill for a like time for the boys of the English High School; and the course of study laid down in Chap. XIV. for the pupils of the Girls' High and Normal Schools, — exercises in vocal gymnastics and physical exercises being required in each class.

A study of the reports of the Committee on Vocal and Physical Culture and Military Drill and of those of Superintendent Philbrick leads inevitably to the conclusion that the instruction given by Mr. Monroe, his assistants and successors, was mainly of an elocutionary nature, supplemented at times by a few rudimentary gymnastics tending to promote voice production; and that genuine physical exercises became a nominal and perfunctory matter in many or most of the lower schools, and in the high schools for girls. On the other hand, it would appear that the requirements in regard to instruction in military drill of the boys, in the various high schools, have been faithfully carried out for twenty-five years, and that to-day the full amount of time accorded to military drill in the Course of Study is given to that subject. Aside from the so-called "Setting-up Exercises" practised during drill hours, and excepting a few spasmodic and short-lived experiments in gymnastics, instruction in gymnastics has not been provided for the boys in our high schools.

In the autumn of 1892, at the request of General Moore, and by permission of the Chairman of the Committee on High Schools, an improved and enlarged series of "Setting-up Exercises," based on Ling gymnastics, was prepared by the Director of Physical Training and his Assistant for use in the School Regiment, and the new exercises have been in use in the high schools for boys for the past year and a half.

The late General Moore expressed himself as being greatly pleased with the working of the new "Setting-up Exercises." The boys entering the high schools undoubtedly have a better carriage than of old, owing to the gymnastics taught them in the grammar schools. The requirements of the present course of study in regard to school exercises (including military drill), and the arrangement of study hours for each class, are faithfully complied with in the daily and weekly programmes of the English High and the Public Latin Schools.

The Rules and Regulations of 1868, cited above, remained without essential change till 1876, and reflect the nearest approach made to organizing a general system of physical training in all grades of schools, under the Standing Committee on Vocal and Physical Culture and Military Drill. At this day it must be said that that organization was largely illusory and inadequate. Even during the last years of the Committee, and during the incumbency of Mr. Moses True Brown as teacher of vocal culture in the high schools, it was deemed necessary to provide the Girls' High School with a special teacher of gymnastics. In 1874, and in 1875, the Committee on the Girls' High School asked leave, which was granted, under suspension of the rules, to employ a special temporary teacher of physical culture in that school. In 1876 the School Board, in authorizing the corps of special teachers for high-school service (Roxbury, Charlestown, W. Roxbury, Dorchester, and Brighton having been annexed since 1868), explicitly provided for a "*Special Teacher of Physical Culture*" in the Girls' High School, which privilege has been accorded to that school practically ever since. Since 1881 the Girls' Latin School has been provided with a similar special teacher. The remainder of the high schools, as a rule, have not been allowed such a special teacher. The following table is introduced to show the changes made in the designation of the committee in charge of physical training during the period 1863–93:

TABLE XIII.

SHOWING CHANGES OF DESIGNATION OF THE COMMITTEE IN CHARGE OF PHYSICAL TRAINING IN THE PUBLIC SCHOOLS OF BOSTON, 1863–1893.

Year.	Title of Committee in Charge.	Date of Vote constituting the Committee.
1863 . (1)	Committee on Military Gymnastics and Drill	December 22, 1863.
1864 . . .	" " "	
1865 . (2)	Standing Committee on Gymnastics and Military Drill	December 27, 1864.
1866 . . .	Standing Committee on Gymnastics and Military Drill.	
1867 . . .	Standing Committee on Gymnastics and Military Drill.	
1868 . (3)	Standing Committee on Vocal and Physical Culture	February 9, 1869.
1869 . . .	Standing Committee on Vocal and Physical Culture and Military Drill and Drawing.	
1870 . (4)	Standing Committee on Vocal and Physical Culture and Military Drill.	
1871 . . .	Standing Committee on Vocal and Physical Culture and Military Drill.	
1872 . . .	Standing Committee on Vocal and Physical Culture and Military Drill.	
1873 . . .	Standing Committee on Vocal and Physical Culture and Military Drill.	
1874 . . .	Standing Committee on Vocal and Physical Culture and Military Drill.	
1875 . . .	Standing Committee on Vocal and Physical Culture and Military Drill.	
1876 . (5)	Committee on Military Drill.	
1877 . . .	" "	
1878 . (6)	Committee on High Schools	April 23, 1878.
1879 . . .	" "	
1880 . . .	" "	
1881 . . .	" "	
1882 . . .	" "	
1883 . . .	" "	
1884 . . .	" "	
1885 . . .	" "	
1886 . . .	" "	
1887 . . .	" "	
1888 . . .	" "	
1889 . (7)	Committee on Hygiene, originally appointed June 9, 1885	Put in charge of Physical Training March 12, 1889.
1890 . (8)	Committee on Physical Training	January 16, 1890.
1891 . . .	" "	
1892 . . .	" "	
1893 . (9)	Committee on Hygiene and Physical Training	January 12, 1893.

SPECIAL TEACHERS APPOINTED IN CERTAIN SCHOOLS.

Since 1885 "vocal culture" has usually constituted a part of the work of the special teachers of calisthenics in the Girls' High and Latin Schools, and the present incumbents, viz., Miss Miller and Miss Hussey, are designated Teachers of Vocal and Physical Culture. Beyond nominating these special teachers in the Girls' High and Latin Schools, and a special teacher of gymnastics for the two years ending in June, 1893, in the Brighton High School, the Committee on High Schools does not seem to have evinced special interest in physical training (even since 1876), except in so far as it has declined to allow the appointment of special teachers in this branch in other high schools for girls. During the year 1893–94 the girls of the Roxbury High School, about three hundred in number, have had no instruction in gymnastics, owing to the unwillingness of the Committee on High Schools to provide a special teacher.

COURSE OF STUDY NOT COMPLIED WITH.

It is well-nigh impossible to frame any comprehensive statement that shall be accurate with regard to the high schools for girls as a class, touching the matter of physical training. In the course of study adopted by the Board in 1877, and in the present course of study, adopted in 1890, "gymnastics" was made a required subject for girls in the high-school classes. With the exception of the Girls' Latin School (in which under the present course of study only one hour a week is to be given to gymnastics), two hours of gymnastics per week for each girl in the high schools have been required, by the course of study, since 1877. It is extremely doubtful if the requirements of the course of study have been complied with in this respect in any of the high schools for girls till within a year. It is absolutely certain that for the last few years, the average time given to gymnastics in the high schools for girls has not exceeded

one hour per week for each pupil. In other words, the weekly programmes of the high schools for girls have not usually been constructed so as to secure to each pupil the required amount of instruction in physical training, — even in those schools that are provided with special teachers of the subject. During the school year 1893–94 there has been a marked improvement in several of the high schools in this respect.

SOME REASONS FOR DIVERSITY OF PROGRAMMES.

One reason for this state of things seems to be that physical training in the high schools for girls has been left to take care of itself, and has not been respected as a coördinate required exercise. In certain schools the boys have the preference in the use of the hall for drill-purposes, so that the girls' gymnastics suffer deprivation and neglect. Again, until a year ago, there has been much less interest in the new gymnastics — among the teachers — in the high schools than in the grammar and primary schools.

Another and very weighty reason is to be found in the difficulty of drawing up a programme free from conflict between the different sections of classes, so as to maintain the proper relation of recitation and study-hours. The time allowed to recess and to study-hours is not the same in all the schools; that is to say, rigid conformity to the course of study is not adhered to, and in some instances the programme is crowded and distorted by subjects not provided for in the course of study, so that the gymnastic instruction is abridged. These and other difficulties that might be instanced render it impracticable to draw up a uniform programme in gymnastics for the high schools containing girls. If physical training is to be made genuine and effective, in this class of schools, it is important that the requirements of the course of study with regard to the amount of time assigned to gymnastic exercise shall be complied with.

It may also be mentioned that there is no teacher in any of the high schools for girls who devotes her whole time to gymnastic instruction. The number of boys and the number of girls in the high schools, taken as a whole, is practically the same, but the cost of military drill for the boys is nearly twice as great as the cost of the gymnastic instruction given the girls.

ANOMALOUS RELATION OF DIRECTOR TO WORK IN HIGH SCHOOLS.

As Director of Physical Training I am directly responsible to the Committee on Hygiene and Physical Training; but inasmuch as the jurisdiction of that committee over physical training in the high schools appears not to be altogether clearly defined, my relation to physical training in those schools is somewhat anomalous, not to say embarrassing. I make it a rule, however, to inspect the classes from time to time, and to comply so far as possible with all requests from the head-masters for aid or advice with regard to instruction in gymnastics, though I do not consider myself responsible for the work done in the high schools to the same extent as for that done in the lower schools over which the Committee on Hygiene and Physical Training exercise undisputed jurisdiction.

VALUE OF ADVANCED COURSE IN HIGH SCHOOLS.

It gives me pleasure to state that the character of the gymnastic instruction given in the high schools has made marked progress during the past year, especially in the Charlestown High School and the West Roxbury High School. The gymnastic course in the Charlestown High School is of a higher grade than in any other of the schools, by reason of the fact that it has been provided with a fairly complete set of Swedish apparatus, which was imported from Christiania in Norway. The cost of securing the same and of putting

it in place, in a room specially devoted to gymnastics, was about $600. A few pieces of Swedish apparatus have been put to good use in the Brighton High School during the past three years.

It seems to me to be extremely desirable, and in most cases practicable, that the instruction given in gymnastics in the high schools should be thorough and varied; that it should be adapted to the peculiarities and adequate to the needs of adolescents; and that it should constitute a distinct advance beyond the grammar-school course in gymnastics, which has hitherto been confined to free standing movements. It is impossible to secure these ends without proper apparatus and competent teachers.

SUGGESTIONS.

The following suggestions are respectfully submitted, as tending to improve the present condition of physical training in the high schools: (1) That the Committee on Hygiene and Physical Training and the Committee on High Schools take measures to arrive at an understanding with regard to the nomination and supervision of teachers of physical training in the high schools; (2) that the Committee on Hygiene and Physical Training and the Committee on High Schools take concerted action towards preparing a programme for each high school, in accordance with the course of study, so far as the requirements of the same in regard to physical training are concerned; (3) that the Roxbury High School be provided with a special teacher in Ling gymnastics, until a regular teacher, competent to teach the same, can be secured.

THE SEATING OF PUPILS.

On October 25, 1892, the School Committee, as is shown by its minutes, took action as follows:

Mr. Green, for the Special Committee on the Seating of Pupils, offered the following:

Whereas a carefully prepared report to the School Committee, by a competent expert, on the seating of pupils in the public schools (School Document No. 9, 1892), has been printed and distributed to all teachers in charge of rooms, it is hereby

Ordered, That the Supervisors and the Director of Physical Training be and hereby are directed to ascertain, in their visits to their respective schools, whether or not the said report has been received and studied by the teachers, and whether intelligent effort is made on the part of the teachers to seat their pupils in accordance with the teachings of the report, as far as the present provision of school furniture will allow.

Ordered, That the Supervisors and the Director of Physical Training be directed to render to teachers any needed advice and assistance in the seating of pupils, and to include in their next reports to this Board the general results of their observations, and any suggestions pertaining to the proper seating of pupils which they may think desirable to bring to the notice of the School Committee.

Accepted, and the orders passed.

In obedience to the orders cited above, I have made a somewhat special study of the conditions which obtain in our schools in regard to the seating of pupils. I have informed myself of the peculiarities of certain forms of adjustable desks and chairs recently put upon the market; and have rendered such assistance and advice to teachers in the seating of pupils as lay in my power.

GENERAL CONCLUSIONS.

Before entering upon the discussion of certain particular topics suggested in the above orders, the general conclusions which I have reached in this matter may be stated as follows:

1. Little if any improvement has been made in the methods of seating pupils in the Boston schools since Superintendent Philbrick's efforts, some twenty-five years ago, to secure desks and chairs of improved construction.

2. The method of seating which now prevails is so arbitrary, antiquated, and inadequate that it needs amendment.

3. The desks and chairs which are customarily furnished, although they are durable and well made when considered simply as articles of manufacture, do not conform as regards their design and construction to the recognized principles of modern school-hygiene.

4. The present condition of things appears to be due to the fact that the designing, selection, and distribution of the school-furniture now in use have been left too largely in the hands of interested and inexpert persons, who were practically outside the jurisdiction of the School Committee. Our methods of seating, therefore, have not kept pace with the progress made in those parts of the world in which expert knowledge has been turned to practical account in the attempt to solve the problems involved.

5. Certain manufacturers of school-furniture have recently shown an active disposition to improve the quality of their wares, especially in the direction of devising adjustable desks and chairs. This is a hopeful sign of the times. Still, the present state of their art is so rude and undeveloped, and is so likely to undergo further change and improvement, within the next few years, that the wisdom and expediency of adopting any of the newer and so-called improved American systems of seating, except in a tentative and experimental way, may be doubted seriously.

6. The problem of providing our school-population with desks and seats which shall adequately meet the requirements of growing children is one of vital importance. It is also an intricate and difficult problem, since it involves questions of a medical nature, in addition to questions which pertain to mechanical engineering and to the practical management of schools. The best interests of pupils, teachers, school-managers, and of manufacturers as well, all demand the adoption of more comprehensive and active measures

than have been taken as yet in this country. To enlighten the public mind with regard to the essential principles involved in the construction and use of school-furniture, it is eminently desirable, to say the least, that the whole problem of seating should be authoritatively pronounced upon by a commission of disinterested men, who are competent and willing to avail themselves of the best that has been attempted or accomplished by similar commissions in Europe during the past ten years. The conclusions and recommendations of such a commission, if it were appointed and supported by a representative organization such as the Massachusetts State Board of Health, the Massachusetts Medical Society, or the State Board of Education, or by the conjoint action of all three, could hardly fail to prove widely influential in promoting the public welfare. By hastening the settlement of vexed questions, and by obviating the necessity of costly and partial experiments, with all manner of "improved chairs and desks" on the part of the school boards of the Commonwealth, such a commission would save the cost of its investigations and publications many times over to the taxpayers of the State.

DR. SCUDDER'S REPORT.

School Document No. 9, 1892, was prepared by Dr. C. L. Scudder, of this city, and embodied the results of his "careful inquiry into the seating in detail of over 3,500 of the school-girls of the Grammar and High Schools." The scope and nature of Dr. Scudder's inquiry is indicated by the title of his report, given below:

An Investigation into one of the Etiological Factors in the Production of Lateral Curvature of the Spine — Reasons why the Seating of School-Children should receive very Careful Supervision.

Dr. Scudder characterizes the method of supplying school-furniture as follows:

The method of providing seats and desks for the various school-houses of Boston is somewhat as follows:

A school-house is built and ready for seats. The Commissioner of Public Buildings, or his assistant, having ascertained the grade of the school and the number of pupils to be accommodated in each room, sends an order to the manufacturer of school furniture who is fortunate enough to hold the contract for the current year, to seat and desk the building. The manufacturer, knowing approximately the ages of the children who will attend a school of the given grade, provides desks and seats as he sees fit, furnishing one, two, or three sizes to a single room, as he is inclined, or as may have been suggested by the head-master of the school.

How does the manufacturer determine the sizes that shall be sent to meet the requirements of certain ages? After corresponding and talking with those who have supplied for many years large cities and Boston with school furniture, I find it impossible to learn how the standard of the height of desk and chair has been determined. The standard for the gradation of the modern school-desks has evidently been handed down from one generation to the next, until it can no longer be traced to its originator.

Out of 37 rooms examined, only 13 were found to be provided with as many as two sizes of desks and chairs. "In every instance," says Dr. Scudder, "where these two sizes are found there are only a few of the second, and the difference in sizes is often scarcely noticeable. With very few exceptions it is true that girls of the grammar schools in any one room sit in the same-sized seats, and at desks of uniform height."

The report contains tabulated statements showing the range of age and the range of height exhibited by the pupils of 6 girls' schools; the data concerning 34 rooms are complete. We may divide these rooms into two classes, viz.: (1) those with desks of *one size* only, and (2) those with *two sizes* of desks. Of the former there were 21, of the latter 13 rooms. In 21 rooms, in which the desks were of one size only, the average difference between the height of the tallest and shortest girls amounted to 31.3 centimeters,

or 12.26 inches; and the average difference between the ages of the oldest and youngest girls was 5 years and 4 months. In 13 rooms, which contained desks of two sizes, the average difference in height between the tallest and shortest girls was 41.14 centimeters, or 16.26 inches; and the average difference in age between the oldest and youngest pupils was 6 years and 2 months.

The report contains twelve plates which serve "to illustrate a few of the faulty positions taken because of the disproportion between child, seat, and desk."

Dr. Scudder states his conclusions as follows:

1. The present method of seating the school-houses of Boston is at fault, in that children are compelled to sit in desks unsuited to them.

2. This method of seating tends to the production of permanent deformity of the spine.

3. The poor seating in our schools has not been hitherto sufficiently emphasized by orthopædic surgeons as a cause of spinal deformities.

4. A larger number of different-sized desks and seats, or adjustable desks and seats, should be provided for each school-room.

5. The teachers of the public schools should be impressed with the fact of the importance of maintaining erect positions, both in sitting and standing.

6. Having greater variety in sizes of seats and desks, and recognizing the danger of malpositions in sitting, great care should be used to seat each child before a desk and in a chair as nearly as possible her proper size.

7. The desk should be low enough to just allow the bent elbow to touch it when the hand is raised to write without raising the shoulder or tilting the trunk.

8. The chair should permit easy contact of the whole sole of the shoe with the floor when the child sits well back in the seat.

9. The foot-rests should be used more than at present, not only to support the foot and leg, but to give a feeling of support to the whole trunk, and to prevent the slipping forward of the buttocks upon the chair, causing one of the commonest of bad postures.

10. The present system of gymnastics in use in the public schools will help to overcome slight tendencies to deformity which might go unchecked and lead to disastrous results.

In spite of the fact that Dr. Scudder's valuable report was "distributed to all teachers in charge of rooms," my investigation of the seating of pupils in more than one hundred sample rooms, taken at random, leads me to conclude that no considerable effort has been made by the teachers to seat their pupils in accordance with the teachings and recommendations of that report. Furthermore, I cannot discover that the method of providing new school-houses with desks and chairs has been materially changed on account of Dr. Scudder's demonstration of its inadequacy, though the School Committee has authorized the use of crickets for children obliged to occupy seats too high for them. I have found in several instances that the requisitions for crickets had been ignored or denied. I would respectfully recommend that a sufficient number of crickets be supplied forthwith for use as foot-rests.

In passing to an account of my own investigations, made subsequently to Dr. Scudder's, it is proper to state that I quite agree with Dr. Scudder's criticisms and recommendations, and that the results of my investigations tend to corroborate and confirm his conclusions.

Malposition in writing, especially when unsuitable seats and desks are used, is a powerful factor in producing spinal deformity among school-girls. Indeed, lateral curvature of the spine has been characterized, by more than one surgical authority, as "the writing position, become fixed." One of the most cogent arguments for the introduction of the so-called vertical script is that it conduces to normal and safe positions in writing.

STUDY OF SEATING IN ONE HUNDRED ROOMS.

Dr. Scudder's investigations were confined to grammar schools for girls. It seemed best to me to include all grades of school in my study of seating. Accordingly I noted the

conditions found in one hundred class-rooms, taken at random, in primary, grammar, and high schools; in old, middle-aged, and new buildings; in boys' schools, in girls' schools, and in mixed schools. No effort was made either to avoid or seek the rooms investigated by Dr. Scudder. In general, I found a relatively larger number of rooms provided with more than one size of desks and chairs than did Dr. Scudder. But it should be noted that the mere provision of three sizes of desks is no guarantee against misfitting, as I found misfits in rooms containing three sizes of desks. In one such room, in a grammar school, I found that more than one-half of all the pupils were misfitted. It was a room which had been assigned to third-class boys for very many years, though it was fitted with desks and chairs intended for fourth-class boys.

The following figures relate to two kinds of misfit only, which for convenience are characterized as "minus-misfits," i.e., when the pupil is unable to assume an erect sitting position, with both feet flat on the floor, owing to contact between his knees and the under surface of his desk, and "plus-misfits," i.e., when the pupil, in the erect sitting position, is unable to put both feet flat on the floor — the seat being too high.

Of the 100 rooms alluded to above, there were only 18 in which no case of misfitting was found, while 733 cases of misfitting were found in the remaining 82 rooms, which contained upwards of 3,600 pupils in actual attendance. In other words, misfits were found in 82 per cent. of the classes examined, and 20.27 per cent. of the pupils in those rooms were misfitted; 8.76 per cent. of the pupils presented "minus-misfits," and 11.51 per cent. of them presented "plus-misfits." Of the whole number of misfits noted, 317 or 43.24 per cent. were minus-misfits, and 416 or 56.76 per cent. were plus-misfits, which goes to show that the number of children forced to sit in chairs that are too high is considerably greater than the

number of those obliged to use chairs and desks that are too low. In one of the high schools for boys, about one-third of the members of the first class were found occupying desks which cramped their knees, though the desks in question were of the largest size.

In 16 night-school classes, with 627 pupils in attendance, misfits were found in all but 2 rooms; 144 minus-misfits, but no plus-misfits, being found in 14 rooms containing 554 pupils. In other words, 23 per cent. of all the pupils examined were placed at desks which were too small for them. The ill effects of misfitted desks and chairs upon night-school pupils are trifling in comparison with such effects upon the rapidly growing children who make up the population of the day schools.

In one of the evening schools I was surprised to find that the tables and seats used by the pupils in the classes in mechanical drawing were uniformly of one size and unadjustable. The use of such tables is a common one, I believe. So, too, is the use of work-benches fixed at a uniform height for pupils in manual training. If pupils in drawing and manual-training classes were all of one size and height, the use of tables and benches of a single size might be justified. But classes of single-sized boys are uncommon, to say the least.

The effects of stooping, cramped, and deforming attitudes, which the use of fixed furniture entails upon pupils in mechanical drawing and manual training, are no less injurious certainly than the evil effects of forcing children to occupy unsuitable desks and chairs for hours daily. It is easy to account for the failure of most manufacturers of school-desks and chairs to study and apply the laws of animal mechanics which are involved in sitting, reading, and writing; but it is rather startling to find that the apostles and teachers of manual training and of mechanical drawing — who are nothing if not mechanical — are so oblivious and blind-minded to the mechanical laws which underlie and condition

the easy, healthful, and effectual action of the organs concerned in vision and manipulation, not to speak of those which serve to ventilate and distribute the blood. If the use of unhygienic tables, benches, and seats in teaching the arts alluded to be an unavoidable necessity, — which may be doubted, — then it is all the more necessary that general physical training and corrective gymnastics should be given a larger prominence than is accorded them, at present, by the advocates and governors of manual and industrial training.

While it would be unjustifiable to assume from the data given above in regard to 100 rooms that 20 per cent. of the pupils in 82 per cent. of all the school-rooms belonging to the city are misfitted in respect to their desks and chairs, it does seem to be tolerably clear that there is an undue amount of such misfitting, and that Dr. Scudder was right in saying, "A larger number of different-sized desks and seats, or adjustable desks and seats, should be provided."

GYMNASTICS AS A PALLIATIVE AND PREVENTIVE.

Dr. Scudder is of the opinion that "the present system of gymnastics in use in the public schools will help to overcome slight tendencies to deformity which might go unchecked and lead to disastrous results." In view of the opinion which I have expressed already in this report, with regard to the nature and effects of gymnastic exercises, I may be absolved from any intention of undervaluing the hygienic worth of physical training, when I venture to express the belief that it is too much to expect of any system of physical training (be its exercises free standing movements, exercises with hand apparatus, or exercises on gymnastic machines, if the time allowed it be limited to 16 minutes a day, as is the case in our grammar schools), that it should effectually counteract or prevent the evil effects of a system of seating which forces so large a number of pupils

who are city-bred to sit for some 200 minutes each day in seats that tend directly to produce discomfort, exhaustion, and deformity. The specific remedy for the evils which result from antiquated and unscientific methods of school-seating is not to be found in physical training, or in an abundant supply of crickets, or in the use of vertical script, but in the substitution of properly constructed seats for improperly constructed seats. Given seats and desks that are correctly constructed, much misfitting may arise if they are misplaced with relation to each other, or if the various sizes are graded according to an arbitrary or fallacious scale, or if the assortment of sizes furnished for a given class does not correspond to the assorted sizes of the children who form the class, or if the class-teacher exemplifies the doctrine that men see with their eyes rather than their brains. Consideration of the structural peculiarities of the Whitcomb desks and chairs, which constitute the great majority of those found in our schools, may profitably be deferred till after some account of the manner in which misfitting has been caused by putting ill-assorted seats into school-rooms, and of the measures taken to obviate this difficulty in providing the new Agassiz School-house with new furniture.

I selected the Agassiz School, at Jamaica Plain, as a favorable place for study and experiment in the matter under consideration, partly because its new building was in course of erection, but chiefly because of the zeal and intelligence shown by its master, Mr. J. T. Gibson, in his efforts to secure better seating in the new house than had obtained in the old one. It is but fair to say that the seating of the pupils in the old Agassiz Grammar School was less objectionable than that found in many other districts, as there were an unusual number of rooms provided with two and even three sizes of desks, and exceptional care had been taken to make the best of the seats furnished.

Still 6.2 per cent. of the pupils in the grammar school were found to be misfitted in January, 1893. In February, 1894, I found the proportion of misfits in the new building reduced to 1.2 per cent.

Mr. Gibson kindly undertook to determine the height of the pupils in his district, 668 in all, in January, 1893, and twice repeated his measurement of all grammar-school pupils (boys), between that date and February, 1894; and placed all his measurements at my disposal. The age of each pupil was noted in addition to his height. These series of measurements were used in determining how many of each size of Whitcomb desks and chairs should be placed in the new school-rooms.

Eight sizes are included in the Whitcomb scale, which purports to "embrace all the heights and sizes for pupils of the age of 5 years to 18 and upwards." The Whitcomb scale is set forth in the following tabular view:

Scale-number.	VII.	VI.	V.	IV.	III.	II.	I.	I. Extra.
Corresponding age, year	5–6	6–7	7–8	8–10	10–12	12–14	14–16	16–18
Height of chair, inches	10.5	11.25	1[illegible]35	14.5	15.5	16.75	16.75	16.75
Height of desk, inches	20.5	21.50	23 0	24.5	25.5	27.0	28.5	29.0
Difference between heights, inches . .	10.	10.25	1[illegible]15	10.0	10.0	10.25	11.85	13.25

It will be noticed that the gradation of sizes is based on the age of the pupil for whom the furniture is intended. Experience and reason show that height is a more accurate and serviceable criterion than age in this field, and that sitting-height is a better criterion than total height. But, as we do not know the sitting-height of Boston children at each year of school age, I have availed myself of the average heights of Boston school-children as determined by Dr. H. P. Bowditch, in 1875, in changing the

Whitcomb age-scale to a height-scale, which is given below:

Scale-number.	VII.	VI.	V.	IV.	III.	II.	I.	I. Extra.
Range of height in inches	41–43	44–45	46–47	48–51	52–54	55–59	60–64	65+
Corresponding age, in years	5–6	6–7	7–8	8–10	10–12	12–14	14–16	16–18

The following table is introduced to show the number of seats of each size necessary to seat the 668 pupils of the Agassiz District, in January, 1893, according (1) to the Whitcomb age-scale, and (2) the same scale expressed in terms of height:

TABLE XIV.

SHOWING THE DISTRIBUTION BY AGE AND HEIGHT OF THE PUPILS OF THE AGASSIZ DISTRICT, JANUARY, 1893, AND THE COMPARATIVE NUMBER OF DESKS AND CHAIRS REQUIRED ACCORDING TO WHITCOMB SCALE, I.E., (1) ACCORDING TO AGE, AND (2) ACCORDING TO SAME SCALE EXPRESSED IN TERMS OF HEIGHT.

Height.		Age in Years.															Total number of pupils at each height.	Whitcomb Scale reduced to inches, etc.
Inches.	Centimeters.	21.	17.	16.	15.	14.	13.	12.	11.	10.	9.	8.	7.	6.	5.	?		
71	180.3				1												1	
70	177.8				1												1	
69	175.2			2	2												4	
68	172.7				0	0											0	I. + 34
67	170.1				1	1											2	
66	167.6		2	1	3	2											8	
65	165.1	1			7	7	1		1							1	18	
64	162.5			2	3	2											7	
63	160.2				3	5	1										9	
62	157.4				4	3	7	2									16	I. 77
61	154.9				3	13	4	2	1								23	
60	152.4			1	3	12	3	3									22	
59	149.8			1	5	2	9	5	1	1							24	
58	147.3				5	8	7	10	2	1	1						34	
57	144.7				1	4	11	15	5		1					1	38	II. 180
56	142.2			1	2	4	7	15	8	3							40	
55	139.7					5	9	6	14	8	2						44	

54	137.1	. . .	. . .	. . .	. . .	. . .	2	10	26	17	4	2	. . .	. . .	. . .	. . .	61		
53	134 6	. . .	. . .	. . .	. . .	. . .	5	6	14	15	2	1	1	. . .	. . .	. . .	44	III.	153
52	132.0	. . .	. . .	. . .	. . .	. . .	4	3	11	13	11	3	. . .	. . .	. . .	. . .	48		
51	129.5	. . .	. . .	. . .	. . .	. . .	. . .	1	6	9	16	3	2	. . .	. . .	. . .	37		
50	127.0	. . .	. . .	. . .	. . .	. . .	1	. .	. . .	7	11	15	2	. . .	. . .	. . .	36		
49	124.4	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	5	4	14	1	. . .	. . .	. . .	24	IV.	120
48	121.9	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	4	12	3	1	. . .	. . .	23		
47	119.3	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	1	. . .	4	14	2	. . .	. . .	21		
46	116.8	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	1	. . .	5	10	1	. . .	. . .	17	V.	38
45	114.3	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	3	4	8	2	. . .	17		
44	111.7	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	1	. . .	5	3	5	. . .	14	VI.	31
43	109.2	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	2	10	5	. . .	17		
42	106.6	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	3	6	2	. . .	11	VII.	35
41	104.1	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	3	4	. . .	7		
40	101.6	. . .	. . .	. . .	. . .	. . .	. .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	0		
Total number of pupils at each age		1	2	3	44	68	71	78	89	81	57	65	50	32	20	2	668		668

Summary.	Whitcomb Seats.	Extra I. +	I.	II.	III.	IV.	V.	VI.	VII.		
1.	Seats called for by age-scale	11	112	149	170	122	50	32	20	2	668
	Seats furnished	0	88	148	141	156	60	81	28		702
	Difference	− 11	− 24	− 1	− 29	+ 34	+ 10	+ 49	+ 8		
2.	Seats called for by height-scale	34	77	180	153	120	38	31	35		668
	Seats furnished	0	88	148	141	156	60	81	28		702
	Difference	− 34	+ 11	− 32	− 12	+ 36	+ 22	+ 50	− 7		

The above table shows the number of pupils, at each inch of height from 40–71, and at each year of age from 5–21, in the Agassiz District, at the time mentioned. The totals at the bottom of the table are grouped to show the number of seats called for by the Whitcomb age-scale; and the totals at the right of the table are grouped to show the number of seats called for by the height-scale given above. In the summary, the number of seats of each size actually furnished is also given. From inspection of the figures in the column marked "Difference," it will be seen that the assortment of seats actually furnished does not correspond with either scale, i.e., the seating was arbitrary and hap-hazard. Judging by the Whitcomb age-scale, the standard purporting to be used, we find that too many seats ranging in size from VII.–IV. and too few of sizes III.–I. Extra were furnished. Of misfits 41, or 6.1 per cent., were found among 668 pupils; of these 29, or 6.2 per cent., were in the grammar grade, and 12, or 5.8 per cent., were in the primary grade.

One of the most striking facts brought out by the three series of measurements in respect to height — made of the pupils of the Agassiz Grammar School, who were all boys — is the variation of the average height in the same class from year to year, and even from half-year to half-year. This variation, which is inevitable in classes whose pupils are growing at a rate of from 1–3 inches annually, greatly enhances the difficulty of providing a sufficient number of seats and desks of assorted sizes, *unless the seats and desks are adjustable.* The appended tables serve to show how the demands for assorted sizes may vary at short intervals in the same class-room, owing to the changing stature of the pupils.

TABLE XV.

SHOWING PER CENT. OF DESKS AND CHAIRS OF EACH SIZE (NO. I. EXTRA–NO. VI.) CALLED FOR (1) BY AGE–SCALE, (2) HEIGHT–SCALE, AND (3) THE PER CENT. OF EACH SIZE ACTUALLY FURNISHED: A. IN OLD AGASSIZ GRAMMAR SCHOOL; B. IN NEW AGASSIZ SCHOOL–HOUSE.

Whitcomb-scale Number.		No. I. Extra.		No. I.		No. II.		No. III.		No. IV.		No. V.		No. VI.		Misfits.		No. of sizes furnished.	
	Per cent. of each size.	A.	B.	A.	B.	A.	B.	A.	B.	A.	B.	A.	B.	A.	B.	A.	B.	A.	B.
Class I.	Called for by age scale	14.6	2.6	73.1	7.6	12.1	21.0	1.8											
	Called for by height-scale	41.5	28.9	39.0	39.4	19.5	31.5	3.7											
	Actually furnished	0.0	13.1	50.0	47.3	50.0	39.4	13.7	...	...	...	..	...	...	...	9.7	0.0	2	3
Class II.	Called for by age-scale	7.4	7.6	51.8	51.9	38.8	40.3	1.8	0.0										
	Called for by height-scale	16.7	17.3	33.3	30.7	46.3	44.2	3.7	7.6										
	Actually furnished	0.0	5.7	41.3	38.4	44.8	50.0	13.7	5.7	...	...	...	...	...	...	7.4	0.0	3	3
Class III.	Called for by age-scale	0.0	8.9	27.2	26.7	63.6	57.1	9.0	7.1	0.0									
	Called for by height-scale	3.6	7.1	29 1	32.1	54.6	48.2	10.9	12.5	1.8									
	Actually furnished	0.0	0.0	40.6	25.0	30.5	50.0	28.8	25.0	0.0	...	...	...	...	...	1.8	1.7	3	3
Class IV.	Called for by age-scale	0.0	5.3	19.7	19.6	44.3	51.7	36.0	23.2	...	0.00								
	Called for by height-scale	4.9	12.5	16.4	19.6	44.3	50.0	34.4	16.0	...	1.7								
	Actually furnished	0.0	0.0	1.6	12.5	51.3	39.2	40.9	37.5	...	10.7	...	...	...	...	6.5	7	2	4

TABLE XV.— *Continued.*

Whitcomb-scale Numbbr.		No. I. Extra.		No I.		No. II.		No. III.		No. IV.		No. V.		No. VI.		Misfits.		No. of sizes furnished.	
	Called for by age scale . .	1.6	7.1	25.0	8.9	35.0	50.0	36.7	32.1	1.6	1.7								
Class IV.[2] .	Called for by height-scale .	3.3	3.5	16.7	19.6	40.0	51.7	35.0	25.0	5.0	0.0								
	Actually furnished . . .	**0.0**	**0.0**	**1.5**	**14.2**	**17.6**	**46.4**	**52.3**	**28.5**	**28.0**	**10.7**	. . .	. . .	. . .	. . .	**6.6**	**0.0**	**4**	**4**
	Called for by age-scale . .	. . .	0.0	. . .	19.6	. . .	48.2	. . .	32.1	. . .	0.0								
Class IV.[3] .	Called for by height-scale	. .	1.7	. . .	12.5	. . .	53.3	. . .	32.1	. . .	0.0								
	Actually furnished . . .	. .	**0.0**	. . .	**0.0**	. .	**44.6**	. . .	**42.8**	. . .	**12.5**	. . .	. . .	. . .	. . .	. . .	**5.3**	. .	**3**
	Called for by age-scale . .	0.0	. . .	14.7	1.7	37.7	23.2	44.3	60.7	3.3	14.2	0.0	0.0						
Class V. .	Called for by height-scale .	1.6	. . .	8.2	3.5	49.2	33.9	32.8	39.2	6.6	19.6	1.6	3.5						
	Actually furnished	**0.0**	. . .	**0.0**	**0.0**	**20.6**	**26.7**	**38.0**	**46.4**	**41.2**	**19.6**	**0.0**	**7.1**	. . .	. . .	**3.2**	**1.7**	**3**	**4**
	Called for by age-scale . .	. . .	. . .	5.4	3.5	10.7	8.9	71.4	60.7	12.5	26.7	. . .	0.0						
Class VI.	Called for by height-scale .	. . .	. . .	1.8	1.7	28.6	21.4	55.3	39.2	14.3	33.9	. . .	3.5						
	Actually furnished	. . .	. . .	**25.4**	**1.7**	**27.1**	**14.2**	**16.9**	**26.7**	**30.5**	**50.0**	. .	**7.1**	. . .	. . .	**14.2**	**0.0**	**4**	**5**
	Called for by age-scale . .	. . .	. .	1.3	0.0	10.8	5.4	55.4	69.0	32.4	25.4	0.0	0.0	0.0					
Class VI.[2] .	Called for by height-scale .	. . .	. . .	0.0	0.0	21.6	27.2	37.8	40.0	57.8	30.9	1.4	1.8	1.4					
	Actually furnished	. . .	. . .	**1.2**	**0.0**	**13.7**	**18.1**	**35.0**	**32.7**	**50.0**	**41.8**	**0.0**	**7.2**	**0.0**	. . .	**2.7**	**0.0**	**4**	**5**

N.B. — The per cents. in the columns marked A refer to analysis of investigation made in January, 1893; those in columns marked B, to the investigation made in February, 1894. The seats "actually furnished" in the first case purported to correspond to Whitcomb's age-scale. The distribution of the seats occupied in February, 1894, was based on measurement of the height of the occupants of the seats, *and observation of their sitting-height besides.*

The above table is constructed to show the per cent. of seats of each size called for, in each class, by the age and height-scales already cited, at periods a year apart. It also affords a comparison between the distribution of seats actually furnished the pupils of the Agassiz Grammar School, and between the percentage of misfits in the old building and the new building. The figures in the column marked "A" relate to conditions found in January, 1893, while those in the column marked "B" relate to conditions found in February, 1894, after the new building had come into use. The seats actually furnished in fitting up the new building were assorted in accordance with the results of the measurements made in January and September, 1893. Still, the scale based on total height was found to be approximative only, and when the assignment of seats came to be made it was found necessary to adopt the *sitting-height* as the criterion, in many instances. This leads to the conclusion that absolute accuracy in the seating of growing children cannot be secured, unless their individual peculiarities in regard to stature, length of trunk, length of leg, etc., are taken into account. Even where adjustable furniture is used, average heights cannot be implicitly relied upon as criteria.

TABLE XVI.

SHOWING DIFFERENCE BETWEEN PER CENT. OF DESKS CALLED FOR BY WHITCOMB AGE–SCALE, THE SAME EXPRESSED IN TERMS OF HEIGHT, AND THE PER CENT. OF EACH SIZE OF DESKS FURNISHED TO AGASSIZ GRAMMAR SCHOOL, JANUARY, 1893, AND FEBRUARY, 1894.

Scale Number of Desk-size.	Scale.	Per Cent. of Desks. At first measurement, January, 1893.			Per Cent. of Desks. At third measurement, February, 1894.		
		Called for by scale.	Furnished.	Difference.	Called for by scale.	Furnished.	Difference.
No. I. Extra . .	Scale of age	2.3	0.0	−0.3	3.5	0.0	−3.5
	Scale of height	7.3	0.0	−7.3	7.0	17.7	−7.0
No. I.	Scale of age	24.4	17.7	−6.7	20.9	17.7	− .2
	Scale of height	16.4	17.7	+1.3	16.8	17.7	+0.9
No. II.	Scale of age	31.6	31.1	−0.5	34.3	31.1	−3.2
	Scale of height	38.0	31.1	−8.9	40.5	31.1	− .4
No. III.	Scale of age	34.1	29.8	−4.3	33.0	29.8	−3.2
	Scale of height	27.9	29.8	+1.9	34.5	29.8	−4.7
No. IV.	Scale of age	7.3	21.0	+13.7	8.1	21.0	+12.9
	Scale of height	9.5	21.0	+11.5	9.9	21.0	+11.1
No. V.	Scale of age	0.0	0.0	0.0	0.0	0.0	0.0
	Scale of height	0.4	0.0	−0.4	1.0	0.0	−1.0
No. VI.	Scale of age	0.0	0.0	0.0	0.0	0.0	0.0
	Scale of height	0.2	0.0	−0.2	0.0	0.0	0.0

N.B. — In January, 1893, there were 29 misfits among 462 boys, or 6.3 per cent.
In February, 1894, there were 6 misfits among 481 boys, or 1.2 per cent.

The above table shows that the requirements as regards the number of seats of a given size will vary in a given school according as the pupils vary in height from time to time; and favors the contention that when fixed desks and chairs (graded according to an average-age or an average-height standard) are used, the necessity for re-sorting and re-arranging them is likely to recur frequently. In other words, the above table makes for the superiority of adjustable over fixed desks and chairs.

TABLE XVII.

SHOWING PER CENT. OF DESKS OF EACH SIZE OF WHITCOMB DESKS CALLED FOR (1) BY AGE-SCALE, (2) BY HEIGHT-SCALE, AND (3) FURNISHED IN ACCORDANCE WITH SITTING-HEIGHT OF 481 PUPILS IN NEW AGASSIZ GRAMMAR SCHOOL, FEBRUARY, 1894.

Desk-number.		No. I. Extra.	No. I.	No. II.	No. III.	No. IV.	No. V.	No. VI.
Per cent. of each size.	Called for by age-scale	3.5	20.9	34.3	33.0	8.1	0.0	0.0
	Called for by height scale . .	7.0	16.8	40.5	34.5	9.9	1.0	0.0
	Furnished according to sitting-height	1.6	14.1	36.3	28.4	16.8	2.4	0.0
	Differences bet. height and sitting-height scale	5.4	2.7	4.2	6.1	6.9	1.4	0.0

Experiment showed, in the case of the Agassiz School, that less misfitting resulted from assorting desks and chairs in accordance with the sitting-height of pupils than when a scale based on total height was used. Table XVII. is introduced to illustrate the difference between the requirements of the age, height, and sitting-height scales, as applied to the

problem of providing a sufficient number of assorted sizes of Whitcomb seats for the use of the pupils in the Agassiz Grammar School in February, 1894.

Table XVIII. shows the number of pupils at each inch of height from 41 to 71 inches in the Agassiz district, January, 1893, and affords a comparative view of the number of seats of each size required according to the Whitcomb scale reduced to terms of height, and the standards adopted at Frankfort on the Main, in 1885, by the Prague Commission in Bohemia, in 1892–93, by the Vienna Commission of Experts, and by G. A. Bobrick, C.E., of Boston, the inventor of a system of adjustable desks and chairs. All of the scales but the last mentioned relate to fixed furniture, and all of them are based on average bodily height as a modulus. The scale-numbers of the Bobrick scale stand for positions in which his *three sizes* of desks and seats may be adjusted. It is evident from inspection that adjustable furniture is capable of being much more accurately adapted to pupils differing in height. The Frankfort, Prague, and Vienna scales are based on careful measurements of large numbers of school-children for whose use the variously sized desks were intended. The height of children of different races varies so widely that the adoption for American children of any European height-scale for the purpose of grading fixed seats would almost certainly prove illusive and disappointing. No thoroughly accurate and adequate scale for determining the proper range of height in grading seats for Massachusetts children can be made until large numbers of city and country children in different parts of the State have been measured and remeasured in respect to total and sitting-height. The preparation and promulgation of such a scale might well be undertaken by a Massachusetts School Desk Commission, should such a commission be organized. It is hardly likely that the manufacturers and vendors of school-furniture will ever engage in an undertaking so purely scientific.

TABLE XVIII.

SHOWING NUMBER OF EACH SIZE OF CHAIRS AND DESKS REQUIRED TO SEAT THE 668 PUPILS RANGING IN HEIGHT FROM 41–71 INCHES IN AGASSIZ DISTRICT, 1893, ACCORDING TO VARIOUS SCALES BASED ON BODILY HEIGHT.

Number of pupils at each height		0	7	11	17	14	17	17	21	23	24	36	37	48	44	61	44	40	38	34	24	22	23	16	9	7	18	8	2	0	4	1	1	
Height-Scale.	Inches	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	
	Centimeters	101.6	104.1	106.6	109.2	111.7	114.3	116.8	119.3	121.9	124.4	127.0	129.5	132.0	134.6	137.1	139.7	142.2	144.7	147.3	149.8	152.4	154.9	157.4	160.2	162.5	165.1	167.6	170.1	172.7	175.2	177.8	180.3	
Whitcomb, Boston, Scale Nos.		No. VII.				No. VI.		No. V.		No. IV.				No. III.			No. II.					No. I.					No. I. extra large.							
No. needed of each size		35				31		38		120				153			180					77					34							668
Frankfort Scale Nos. 1885		No. O.				No. I.				No. II.				No. III.			No. IV.					No. V.		No. VI.			No. VII.					No. VIII.	
No. needed of each size		35				69				120				197			136					61		34			15					1	668
Prague Commission's Scale Nos. 1892-93		No. I.	No. II.			No. III.		No. IV.		No. V.		No. VI.		No. VII.		No. VIII.		No. IX.				No. X.		No. XI.			No. XII.							
No. needed of each size		0	35			31		38		47		121		105		84		96				45		32			34						668
Vienna Commission of Experts' Scale. 1892		No. I.						No. II.		No. III.				No. IV.				No. V.				No. VI.					No. VII.		No. VIII.				
No. needed of each size		66						85		121				189				118				55					28		6				668
Bobrick's Scale. Adjustable seats. 1892		No. I.	No. II.		No. III.		No. IV.		No. V.		No. VI.		No. VII.		No. VIII.		No. IX.		No. X.		No. XI.		No. XII.		No. XIII.		No. XIV.		No. XV.		No. ?		
No. at each position		7	28		31		38		47		73		92		105		78		58		45		25		25		10		4		2		668
Seats actually furnished, Whitcomb's sizes, including 34 unoccupied		No. VII.				No. VI.		No. V.		No. IV.				No. III.			No. II.					No. I.					No. I. extra large.							
		29				81		60		156				141			148					85					0							702
Difference		−7				+50		+22		+36				−12			−32					+11					−34							

SCHOOL-DESK REFORM IN AMERICA.

The movement for school-desk reform may be said, in a sense, to have originated in this country. The teachings and efforts of Henry Barnard, Superintendent Philbrick, and others led to the now general custom of providing individual pupils with separate desks and chairs. The practice of seating two or more pupils at the same desk is even now much more common in some European countries than in the United States. But scientific men in America have not shown so much activity or interest, as their brethren in Europe, in the practical study of the principles of school-desk construction in the interim since Barnard's classic work on "School Architecture" appeared in 1860. Much "inventive genius" has been expended on mechanical contrivances tending to cheapen the production of school furniture and to facilitate its convenient use. But with rare exceptions our inventors and manufacturers have contributed but little towards the solution of the real problem, which is to provide each pupil with a seat and desk accurately adapted to his individual needs as a sedentary animal overmuch given to reading and writing. Within the last three years much activity has been displayed by inventors in devising desks and chairs that can be raised and lowered. This is a move in the right direction, since it is likely to awaken the interest and enlist the aid of medical and pedagogical experts in promoting still further progress. Evidence of increased interest in questions pertaining to school-seating, along with other branches of school hygiene, is found in Dr. D. F. Lincoln's "The Sanitary Conditions and Necessities of School-Houses and School Life;" in an article, in Vol. II., No. 1, of the Pedagogical Seminary, on "Outlines of School Hygiene," by William H. Burnham, Ph.D., Docent in Pedagogy at Clark University, Worcester, Mass.; and in the "Seventh Annual Report of the Board of Health

of the State of Maine," by its secretary, A. G. Young, M.D. Dr. Young's report is characterized by a recent German reviewer as "no mere report, but a hand-book on school hygiene." Dr. Burnham's article and Dr. Young's report are particularly valuable because of their judicious and copious citations from recent foreign literature.

NEED OF AN EXPERT COMMISSION.

The activity of inventors and manufacturers in multiplying new forms of adjustable school furniture needs guidance and criticism from competent experts; otherwise the most essential principles of seating will continue to be ignored (as is generally the case at present) and tax-payers will be called upon to make large expenditures for furniture that does not really represent "the present state of the art." If there is to be a radical and thorough-going reform of school-seating among us, it behooves us to take into account the advance that European scientists and manufacturers have brought about during the last twenty years. Thus, and not otherwise, shall we be enabled to begin where they leave off. The best means to secure this end in our Commonwealth would be the constitution of a Massachusetts Expert School-Desk Commission to promulgate a declaration of principles for the guidance of manufacturers, school-boards, and teachers. The hygienic and economic interests involved in this problem are too large and too intricate to permit its solution to be left elsewhere than in the hands of a sufficient number of representative experts.

CONCERNING SCHOOL-DESKS IN BOSTON IN 1841.

The following extract from a report to the Boston School Committee, made by Mr. George S. Hillard, Chairman of the Annual Committee for the Grammar Department, Aug. 3, 1841, possesses some historical interest:

The schools are too crowded and the seats are not properly constructed. There is not a single school which has come under the observation of your committee in which the seats are adapted, as they ought to be, to the young and growing frame. Especially do the girls suffer from this cause, from their greater delicacy of organization and less hardy habits of exercise. Such seats cannot be viewed without pain by any one acquainted with the principles of physiology. Their inevitable tendency is to produce diseases of the spine and chest, and to lay the foundation of chronic complaints, which will embitter life, if they do not shorten it. Public attention is not called to this subject, because the connection is not perceived between the cause and the effect; but if the community could only realize the extent of the evil, and have brought before their senses, in some perceptible form, the consequence of this violation of the natural laws, we believe that a reform would be insisted upon, and no consideration of economy would be allowed to stand in the way of it. Indeed, a truly enlightened economy, no less than higher motives, would make the health of our children a matter of the first importance and remove or alter every thing that operated unfavorably upon it.

COHN'S STUDY OF SEATING IN RELATION TO MYOPIA.

School-desk reform first became a burning question in Europe, owing to the results of the investigation which Dr. Cohn, Professor of Ophthalmic Science in the University of Breslau, made in 1865 of the eyes of 10,060 Breslau school-children. Summarily stated the investigation showed that "*in every school the number of short-sighted children increased from class to class.*" Cohn was led to attribute in large measure the increase of short sight to the use of bad desks. His remarks on this subject are of special interest, as may be seen from the following passage taken from the English translation of his "Hygiene of the Eye in Schools," published in London in 1886:

Many years ago the orthopædic doctors had pointed out the *school-desk* as the thing above all others tending to originate spinal curvature. The American writer, Barnard, in his great work on "School Architecture" (1860) upheld the principle that during writing the form (bench) ought to be close up to the desk. Schreber, Schraube, Passavant, Freygang,

Fink, and Zwez also insisted on the importance, for the scholars' normal growth, of well-constructed desks; but they did not see wherein lay the very chief defect of the old school-desks.

The question was dealt with from a wholly new point of view by Dr. Fahrner, of Zürich, who in his small but classical book "The Child and the School Desk" (1863) pointed out *why* the children could not possibly sit upright for long at a time at the old desks, why they were forced to fall forward, and why a thorough reform in the make of school-desks was necessary. . . . When in 1865 I had studied Fahrner's admirable work and had begun my examination of the eyes of the Breslau school-children, the question pressed itself upon me: How far may the old desks in our schools be answerable for the origin and development of short sight?

To obtain an answer to this question, I first of all measured the height of 10,060 children in the 166 classes examined. I then measured the desks with reference to desk-height (back and front), desk-width, form-height, and form-width, difference and distance between desk and form, between form and foot-board, etc. I thus found that these old desks were *opposed to every reasonable hygienic requirement*, and were set up quite arbitrarily and without any reference to the height of the children in the classes. Pupils three feet six inches and five feet two inches in height sat at the same desk. [*Misfitting nearly as bad as this can still be found in Boston schools.*]

But apart from this fundamental error, I found that scholars, even when the desk was suited to their height, *were forced* by the old forms (seats) *to stoop forward and bring the eye very close to the writing*. That is just how myopia can be produced and increased.

CARDINAL POINTS IN DESK CONSTRUCTION.

The points which are of main importance in school-desks are four: the difference, the distance, the seat-height, and the desk-slope.

(1.) *The Difference*, that is, the vertical distance, between desk and seat. (See M D, Fig. 1.) The higher the desk-surface the nearer it is to the eye of a straight-sitting child. Thus the greater the difference the more the child will have to exert his accommodation. Now, the writing ought to be from 35 to 45 centimeters [14–18 inches] from the eye, for that is about the distance of a child's eye from the elbow when hanging straight down, and the text of the school-books should be easily legible at that distance. If, however, the difference is great, so that the elbows have to be considerably raised in writing [*as is generally the case in our Boston schools*] the shoulders will not hang from the body, but the body from the shoulders, and the writing hand will be too near the eye.

(2.) An exceedingly important correlative of the difference is the horizontal *Distance* between desk and form. (See D, Fig. 1.) In the right arrangement of distance lies the kernel of the school-desk reform. The greater the distance the more the body will have to fall forward of the seat in order that the arms may reach the paper; and the more will the head be obliged to drop and to get near the writing. Thus, whenever we intend to sit upright at a table for a considerable time, we instinctively push the chair so far under the table that the table's edge is vertically over the chair's edge, or, if possible, overhangs it by an inch. *For the upright position of the head, therefore, the distance must be nil or, still better, negative.* . . . I once proposed a minus distance of one inch; but after further observations I think that the upright position is sustained still longer when the thigh is supported still further towards the knee, and therefore I agree with Buchner, who requires a minus distance of two inches.

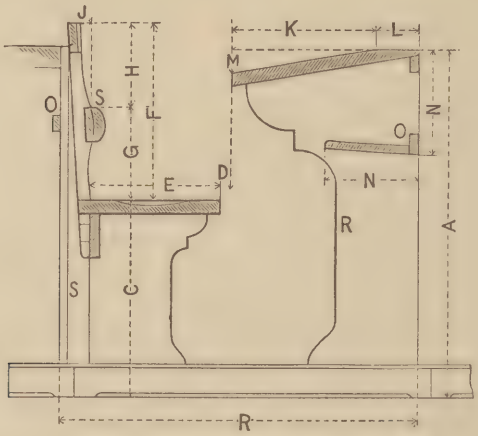
Here every inch is of consequence. No physician has ever opposed the requirement of nil or minus distance . . . the opposition has come solely from *individual teachers.*

(3.) *The Height of the seat.* (See C, Fig. 1.) If the legs are not bent at a right angle at the knee and the feet resting with the entire sole flat upon the foot-board (or floor), the feet must be left dangling in the air. Then the child soon grows tired. He tries to reach the floor with the tips of his toes at least, and in so doing he bends the thigh downward, slides forward on the edge of the seat, and presses his chest on the edge of the table. The necessary result is a further collapse of attitude. (In all this we are leaving quite out of account the hindrance to breathing and the compression of the intestines.) *The height of the seat must accordingly be equal to the length from the knee to the sole, that is, $\frac{3}{7}$ of the child's height.* The knee must be bent at a right angle. No attention is paid to any of these proportions in the old school-desks.

(4.) *The Slope of the desk.* (See K, Fig. 1.) We can read easily, without any stoop of the head, from a book placed *vertically* before us. If the book slopes back at an angle of 45 degrees with the horizon, reading is equally easy, because the eyes can be directed downward without bending the head forward. But if the book lies flat and the reader sits upright, the eyes are turned downward very far. This continued for any considerable time is very tiring and so we prefer to bend the head forward. It follows that the desk must not be horizontal, but sloped. A slope of 45 degrees, however, is not to be recommended, because it would make writing difficult and the writing materials would fall down. A slope of 1 in 6 is the best. The old school-desks are all flat and therefore wrong.

NORMAL DIMENSIONS OF DESK AND SEAT.

Figure 1, adapted from a similar cut in Eulenberg and Bach's "Schulgesundheitslehre, Berlin, 1891," p. 217, will be of assistance to us in further discussing the normal dimensions of desks and seats. It represents the dimensions recommended by Eulenberg and Bach, for a seat and desk adapted to a pupil 175 centimeters (68.89 inches) in height. R, the total depth of desk and seat, equals 78 centimeters. A, the outer height of the desk, equals 74 centimeters. C, the



inner height of the desk, equals the sum of the lines C and M D, *i.e.*, 78 centimeters, — C being 48 centimeters ($\frac{8}{11}$ of the total bodily height), and M D being 30 centimeters, or about 17 per cent. of the total height. The width of the horizontal part of the desk L equals 10 centimeters and that of the sloping part K equals 35 centimeters. The book-shelf N is placed 25 centimeters ($\frac{1}{7}$ of the body-height) below the surface of L, and is 22 centimeters ($\frac{1}{8}$ of the body-height) in width. C, the height of the seat, equals 48 centimeters ($\frac{8}{11}$ of the body-height). The length of the seat equals 58 centi-

meters ($\frac{1}{3}$ the body-height). E, depth or breadth of seat, equals 35 centimeters ($\frac{1}{5}$ the body-height). The total height of the back-support equals 44 centimeters ($\frac{1}{4}$ the body-height); G, the total height of cross-rest (S) for the small of the back, being 22 centimeters ($\frac{1}{8}$ the body-height). The back-support slopes backward, it will be noted, some 3 centimeters, so that J, the shoulder-rest, cannot come into contact with the pupil's back unless the upper part of the pupil's trunk is slightly inclined beyond the perpendicular line J S. This is to enable the pupil to assume the so-called "back-sitting" or "reclined position" which is strongly advocated by Prof. A. Lorenz, one of the most eminent of European orthopædic surgeons. Lorenz's "Die Heutige Schulbankfrage, Wien, 1888," contains the most thorough-going and satisfactory critique of various styles of modern desks that has come under my notice. Eulenberg and Bach recommend the "reclined-sitting position" as the simplest measure for preventing the increase of short-sight among school-children. They also recommend hollowing out the seat to a depth of $1\frac{1}{2}$ centimeters as shown at E, instead of inclining the surface of the seat from front to rear. It will be observed that the line M D, technically called "the difference," does not strike the edge or surface of the seat. The result is that "the distance," *i.e.*, the distance between the rear edge of the desk and the forward edge of the seat, is a plus or positive distance, which was usually found in school-seating twenty-five years ago, but which is almost universally condemned by modern authorities, since it involves the necessity of leaning forward in writing, which is sedulously to be avoided. In the present case the plus distance noted is a concession to convenience, since it is easier for a pupil to get in and out of his seat when the distance is plus than when it is minus; *i.e.*, when the line M D falls inside the line made by the front edge of the seat, or when the distance is nil; *i.e.*, as when the line M D just

strikes that edge. The best European desks are now made so that the desk-plate can be shoved forward to a plus distance for reading or other purposes, and be drawn down to a minus or negative distance of 2–10 centimeters when the desk is to be used for writing. There is no manner of doubt as to the superiority of a desk having a minus distance for writing purposes. The fact that desks set at a positive distance from their chairs are less commonly met with in the Boston schools than might be expected is worthy of special mention.

The dimensions of the desk figured above, which is intended for a pupil 175 centimeters (68.89 inches) in height, can be proportionately increased or diminished, it is claimed by Eulenberg and Bach, so as to furnish the dimensions for a series of desks and seats which shall correspond to the needs of pupils of various heights, so long as there is no marked disproportion between the length of trunk and legs in such pupils. The authors declare that the height of each pupil in a class should be determined at the beginning of each half year, as a guide to assigning him a seat.

Various standard tables, based on bodily height as the modulus, have been promulgated in different parts of Europe to show the dimensions which should be embodied in a series of graded school-desks, for children ranging between six and fourteen years of age. So great is the variation in height among children of the same age belonging to different races and social classes, that it would manifestly be unsafe to adopt a German or Austrian or Russian scale, without modification, as a standard for grading school-desks in Boston or Massachusetts. But the scales adopted in various parts of Europe will repay our careful study since they are based on experiment and reason, and go far towards showing how the problem of school-seating is to be solved.

The following articles are cited for the benefit of those who may wish to make a detailed comparison of some of the

principal tables of standard dimensions adopted by European experts and commissions: (1) "Zur praktischen Lösung der Subsellienfrage von Stadtarzt Dr. A. Spiess in Frankfurt am Main." Deutschen Vierteljahrsschrift f r öffentliche Gesundheitspflege. Bd. XVII. Heft. 2; (2) "Die Schulhygiene auf der Jubiläumsausstellung der Gesellschaft für Beförderung der Arbeitsamkeit, in Moskau, von Dr. Fr. Erismann, Professor der Hygiene an der Universität in Moskau," in Zeitschrift tür Schulgesundheitspflege, 1888, No. 10; (3) "Zur Entwickelung der Schulbankfrage in Prag," *ibid.*, 1893, No. 4; (4) "Schulbankausstellung in Wien," *ibid.*, 1894, No. 7. The article last cited contains a brief account of the exposition of school-desks, held in Vienna, January, 1894, in which 49 styles of desk were exhibited in response to the offer of prizes made by the Vienna Expert Commission in 1892.

The table adopted by the Prague Commission in 1892–93 is introduced below, as it is the latest, and in some respects the fullest and most suggestive, that has come under my notice.

TABLE XIX.

SHOWING NORMAL DIMENSIONS * OF DESKS AND SEATS, I.–XII., GRADED ACCORDING TO RECOMMENDATIONS OF PRAGUE EXPERT COMMISSION ON SCHOOL–SEATING, 1892–93.

Desk Number.	I.	II.	III.	IV.	V.	VI.	VII.	VIII.	IX.	X.	XI.	XII.
1. Age of pupil	**6.**	**7.**	**7.**	**8.**	**8.**	**9.**	**9.**	**11.**	**11.**	**13.**	**13.**	**14.**
2. Height of pupil	95–104	105–110	111–116	117–122	123–128	129–134	135–140	141–146	147–152	153–158	159–164	165 +
3. Height of desk, corresponding to MD and C in Fig. 1	52	55	56	59	61	63	66	68	70	72	75	78
4. Height of seat, corresponding to C in Fig. 1	29	30	32	34	35	36	38	40	41	42	44	46
5. Negative distance	10	10	10	10	10	10	10	10	10	10	10	10
6. Positive distance, corresponding to space D in Fig. 1	8	8	8	8	8	8	8	8	8	8	8	8
7. Difference between desk and book-shelf, corresponding to Z in Fig. 1	10	10	10	10	10	12	12	12	12	12	13	13
8. Difference, corresponding to MD in Fig. 1	23	23	24	25	26	27	28	29	29	30	31	32
9. Inclination of desk, M to L in Fig. 1	18°	18°	18°	18°	18°	18°	18°	18°	18°	18°	18°	18°
10. Inclination of back of seat, JE in Fig. 1	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°	10°
11. Inclination of seat, E in Fig. 1	8°	8°	8°	8°	8°	8°	8°	8°	8°	8°	8°	8°
12. Depth of seat, E in Fig. 1	23	23	24	24	25	25	26	27	28	29	30	31
13. Width of open space between seat and lower edge of back-support	12	12	13	13	14	14	14	14	15	15	15	16

* The dimensions given in this table are given in centimeters.

The desks made according to the Prague-scale number twelve sizes, while most other systems provide for only eight or at most nine sizes of desks. The larger assortment is an advantage, in a system of fixed seats and desks, since it conduces to finer gradation of sizes and a nearer approach to accurate adaptation of seats to the structural peculiarities of their occupants. Lorenz, in the brochure already cited, figures more than 30 styles of school-desk, but not one of them is adjustable for height, though many of them are provided with devices for changing the "distance" between desk and seat from negative to positive and *vice versa*. The Prague desks belong to the latter class.

CONCERNING AMERICAN ADJUSTABLE SCHOOL-DESKS.

Our American adjustable desks are adjustable as regards difference; *i.e.*, the vertical distance between desk-surface and seat-surface, but as a rule are fixed as regards "distance." An ideal adjustable desk and chair should be adjustable not only for distance and difference, but also with regard to the back-support and the desk-slope. The Chauncy Hall School, of this city, is furnished with desks (designed some twenty years since in accordance with the suggestions of eminent Boston surgeons and oculists of that day) which are readily adjustable for distance and desk-slope, but not for difference. The Chauncy Hall desk, though a marked improvement on its predecessors, and most of its contemporaries, has had little or no effect upon manufacturers and inventors, and seems to have been absolutely ignored by school-authorities.

As a rule the back-supports of the fixed chairs used in our schools are inadequate to their purpose, since their backward slope is too great, and they do not provide proper support for the lumbar portion of the pupil's back. The desk-surface is nearly always too high and inclined at too

small an angle. The new adjustable desks, as a rule, are as objectionable as the old in these respects, it may be remarked. It would be bad policy, manifestly, to adopt adjustable furniture in a wholesale way so long as the inventors and makers of such furniture change their adjustment-devices from year to year, and fail to turn out desks and chairs that are hygienic in all respects, instead of in one or two only.

It is extremely desirable, in my opinion, that the present needless misfitting in the Boston schools should be reduced. The most feasible way to reduce it at the present time, as is shown by our experience in fitting up the class-rooms of the new Agassiz Grammar School, is to re-distribute the desks and chairs now in use, so that each room shall have at least three sizes of desks and chairs. In several of the Agassiz School rooms odd-sized desks were placed in the front row, in order to meet the needs of deaf and short-sighted children. Had one or two rows of adjustable desks been placed in each of the Agassiz School rooms, I believe that misfitting, in the sense in which that term is used in these pages, would have been reduced to nothing, or at least to a fraction of one per cent.

Something over a year ago the new primary school in the Prince district was furnished with adjustable desks and chairs. The chairs in question have back-supports that are better adapted to their purpose than is the case with most of the fixed chairs now in use in our schools. But I found a good deal of misfitting in the Prince Primary School, partly because the adjustable feature of the desks and chairs had been too slightly availed of by the teachers in charge, but chiefly because the adjustable desks in question are constructed on wrong principles. They are supported by a central pillar of cast-iron with a wide flange at the bottom. The flanges of the chair and desk-pillars are placed so near each other (and for primary-school children they must be so placed) *as to prevent the children from placing*

their feet flat upon the floor, even when desk and chair are properly adjusted as to difference. It is possible to construct a truly hygienic one-pillared adjustable desk, but I have never seen one. It should be said that the newest forms of adjustable desk are not open to the objection urged above, since they are supported by two brackets, instead of a single central pillar.

It seems not unlikely that an adjustable desk and seat which shall deserve the appellation of "hygienic" will be evolved in the United States within the next ten years, especially if scientific experts can be induced to lend their aid in determining the dimensions and proportions of such furniture. But there is abundant evidence, it seems to me, that the time has not yet arrived for the general adoption of adjustable school-desks by the city of Boston or the cities of Massachusetts. Meanwhile let school authorities, medical and mechanical experts, and manufacturers take concerted action, in order that that time may be hastened!

IN CONCLUSION.

In general terms it may be said that there has been healthy growth and expansion in the department of physical training during the interval since my last report in December, 1891. The policy of holding frequent normal classes for the teachers of the grammar and primary schools has been followed with good results and will be continued. Toward the close of the school-year 1891–92 the experiment was made of examining and marking the grammar-school classes throughout the city, and of furnishing the master of each school with a detailed statement as to the proficiency and rating of the several classes under his charge. The results of this experiment were so stimulating and helpful that the practice has become a fixed policy. It should be said, however, that the detailed statement sent

to each master relates solely to the classes in his own school. The results of the annual inspection and rating serve also for the guidance of the director and his assistant in bestowing special aid to those teachers who need it most.

The novelty of the situation, due to the introduction of an orderly, progressive system of instruction in gymnastics, has worn off for the most part; and the ancient misleading notion that physical training is chiefly useful to afford an easy and inexpensive vent for the ticklesome "animal spirits" of tired and restless children and to enhance the liveliness and attractiveness of school exhibitions has been dissipated to a considerable degree, and bids fair to disappear utterly — at least among the teachers — as time goes on. Increased experience on the part of the teachers in conducting class-exercises in gymnastics at the word of command, and their growing familiarity with the aims and methods peculiar to the Swedish school-gymnastics, have led to marked improvement in the manner and results of their instruction. This improvement has taken place all along the line, but has been particularly marked and gratifying in certain schools and classes in which comparatively feeble interest in the new gymnastics was manifested at the outset.

My main aim is to secure steady, sustained, and increasingly intelligent effort on the part of the class-teachers, so that gymnastics shall become a regular, inevitable part of the daily course of instruction, receiving due attention, no more, no less. To this end, now that the mass of the teachers have acquired a fair amount of technical skill in conducting gymnastic instruction, — I propose to throw greater stress than seemed advisable at first upon the principles of physical training and its relations to other branches of instruction. This is the more necessary as, prior to entering upon their professional work, the great majority of teachers had no

normal training, to speak of, in any form of physical training, properly so called.

The normal schools of Massachusetts, as well as those of the country at large, judging from their generally apathetic, incurious attitude in such matters, have still to learn that physical training has a history and a literature which furnish convincing evidence of the feasibility as well as the desirability of making physical education an organic part of the professional training of teachers in elementary and secondary schools. The present movement for the advancement of physical education can never accomplish its perfect work, so long as public normal schools as a class are content to rest in happy ignorance of the principles, methods, and achievements of modern school-gymnastics and gymnastic games.

The full and lasting success of Boston's present tentative effort to profit by the example and experience, in the field of physical training, of other cities and countries will depend very largely upon the character of the support given to the department of physical training in the Boston Normal School. This school is conspicuous, in its class, by reason of the fact that its managers have taken measures to provide its pupils with theoretical and practical instruction in Swedish school-gymnastics, which measures have been cheerfully seconded hitherto by the School Committee. But the department is still in embryo, and its expansion and efficiency have been hampered by the crowded state of the curriculum and the insufficient resources of the school. Provision has been made, however, in framing the new course of study for the Normal School, for better instruction in gymnastics than was formerly practicable. Gymnastics has been placed in the list of electives, and twelve members of the class of 1893–94 availed themselves of the opportunity to elect it as a special study. Experience shows that the corridors of the Normal School are a poor substitute for a well-fitted

gymnasium. It is wisely proposed to include such a gymnasium in the projected extension of the Normal School building. At the suggestion of the head-master of the school, I have prepared sketch-plans for such a gymnasium. If a well-equipped gymnasium be provided it will add greatly to the usefulness and efficiency of this department, especially if the recently authorized experiment in developing departmental teaching in the grammar schools shall prove a success, and lead to a new departure in the management of those schools.

Grateful and emphatic acknowledgment should be made here of the good will and kindness shown by the Boston Normal School of Gymnastics (established by the late Mrs. Hemenway, whose munificent generosity in so many directions has made the Boston schools her permanent debtor) in allowing the special students of gymnastics in the Boston Normal School to make free and frequent use of its well-appointed gymnastic apparatus.

At the invitation of Dr. Dunton, the Principal of the Normal School, and with the consent of the Committee on Hygiene and Physical Training, I have helped to frame the elective course of study in gymnastics, already alluded to, and have taken part in the instruction given in accordance with it. Since the beginning of February, 1894, I have given seventeen lectures to those members of the senior class of the Normal School who elected gymnastics. The following list of topics will serve to indicate the purpose and character of the lectures: The Modern Doctrine of the Human Body; School Hygiene; The Physiology of Nerve and Muscle, and its Bearing upon the Education of Children and Adolescents; The Nature and Effects of Physical Training; Comparative View of the Principal Systems of Physical Training; Practical Hints on Teaching School Gymnastics.

The reference library of the Normal School has been im-

proved by the addition of a few modern works on anatomy, physiology, and hygiene. The school is sadly in need of preparations, models, etc., for purposes of demonstration and illustration. It is a pity, to say the least, that the pupils of our Normal School should be obliged to waste time, as they are at present, in studying the *elementary facts* of anatomy, physiology, and hygiene, when they might be prepared, on leaving the high school, for the profitable study of the practical application of the *principles* of those sciences to education and school-life, if the high-school course in the biological sciences were properly coördinated and conducted.

Acting under the direction of Superintendent Seaver, and the requirements of the committee charged with preparing the Boston exhibit for the Columbian Exposition at Chicago, I undertook the preparation of a series of photographs to illustrate the most distinctive features of the Swedish gymnastics as practised in our schools. In this, as in other branches of the work of this department, Mr. H. Nissen, Assistant Instructor in Physical Training, rendered valuable assistance. Owing to the inherent difficulty of securing satisfactory photographs of school-classes engaged in gymnastic exercises, the undertaking proved unusually tedious and time-consuming. However, a series of over one hundred views (embracing typical, alphabetic positions, a series of positions illustrating the principle of progression and the composition of the "Day's Order," together with views representing class-work in all the grades) was secured. The exhibit, which proved to be one of the features of the Boston exhibit, was not approached by any exhibit of a similar nature made by any American city. I may add that this exhibit was warmly commended by Prof. L. M. Törngren, who represented the Royal Central Gymnastic Institute in Stockholm (of which he is the director), at Chicago, and by the official representatives of the Prussian Ministry of Education.

During his stay in Boston, in June, 1893, Professor Törngren inspected the gymnastic exercises in many of our schools, and took occasion, both in public and in private, to express his high appreciation of the genuineness and excellence of instruction given by the class-teachers in Swedish gymnastics. Commendation by so eminent an authority was especially welcome and gratifying.

Considerable progress has been made in the past two years towards unifying and simplifying the practice of gymnastics in the classes as regards the times set for exercise, the amount of time devoted to instruction and practice, and the number and selection of the "Day's Orders" attempted. There is now much less diversity in these matters than obtained at first. Having, by periodical circulars of inquiry, practically determined what may fairly be expected and exacted of the several classes, I propose to promulgate a provisional course in gymnastics for the guidance of the teachers during the ensuing year, or so long as it may be found to work well. The drawing up of a uniform scheme of requirements and procedure has been materially facilitated by the School Committee's new rule with regard to recess; by the requirement of the Committee on Hygiene and Physical Training that sixteen consecutive minutes (which is the full time allowed by the amended course of study for the grammar schools) shall be devoted to gymnastics in all classes of the grammar grade at or about the middle of each afternoon session; and by the adoption of Nissen's "A B C in Swedish Educational Gymnastics," as a supplementary desk-book of reference.

In January, 1891, as appears from a statistical inquiry made at the time, only 79.2 per cent. of the grammar and primary school teachers professed to teach Swedish gymnastics in 1,065 classes, while 20.7 per cent. taught "mixed" forms of gymnastics. In January, 1893, mixed gymnastics had practically disappeared, and 1,098 teachers

were returned as teachers of the required Swedish gymnastics.

The following table affords a comparative view of the results of each inspection and rating of the 55 grammar schools, by schools and divisions. The epithets "excellent," "good," etc., are based on the average mark of the school, which is obtained by dividing the sum of the division-marks by the number of the division-marks. Each division-mark is also an average of marks touching five distinct particulars, viz., position, steadiness, precision, correctness, commands.

TABLE XX.

SHOWING COMPARATIVE RATING OF THE FIFTY-FIVE GRAMMAR SCHOOLS, IN PHYSICAL TRAINING, 1891-1894.

		First Inspection in 1891.		Second Inspection in 1891.		Third Inspection in 1892.		Fourth Inspection in 1893.		Fifth Inspection in 1894.	
		Number.	Per Cent.	Number.	Per Cent.	Number.	Per Cent.	Number.	Per Cent.	Number.	Per Cent.
By Schools.	Old Scale.										
	Excellent, 1.00–2.00	8	14.5	8	14.5	39	70.9	53	96.3	54	98.1
	Good, 2.01–2.50	18	32.7	20	36.3	16	29.0	2	3.6	1	1.8
	Passable, 2.51–3.00	17	30.9	20	36.3	0	.....	0			
	Poor, 3.01–6.00	12	21.8	7	12.7	0	.....	0			
		55		55		55		55		55	
	Present Scale.										
	Excellent, 1.00–1.50	.....	.....	.....	.....	5	9.0	15	27.2	20	36.3
	Very Good, 1.51–1.85	.....	.....	.....	.....	19	34.5	31	56.4	25	45.4
	Good, 1.86–2.20	.....	.....	.....	.....	24	43.6	9	16.3	10	18.1
	Passable, 2.21–3.00	.....	.....	.....	.....	7	12.7	0	.....	0	
	Poor, 3.01–6.00	.....	.....	.....	.....	0	.....	0	.....	0	
						55		55		55	

By Divisions.	OLD SCALE.											
	Excellent, 1.00–2.00	. . . . .	. . . . .	. . . . .	. . . . .	342	61.5	466	83.2	499	85.7
	Good, 2.01–2.50	. . . . .	. . . . .	. . . . .	. . . . .	179	32.0	85	15.1	75	12.8
	Passable, 2.51–3.00	. . . . .	. . . . .	. . . . .	. . . . .	29	5.2	6	1.07	6	1.0
	Poor, 3.01–6.00	. . . . .	. . . . .	. . . . .	. . . . .	6	1.7	3	0.53	2	0.3
						556		560		582	
	PRESENT SCALE.										
	Excellent, 1.00–1.50	. . . . .	. . . . .	. . . . .	. . . . .	104	18.7	217	38.9	260	44.6
	Very good, 1.51–1.85	. . . . .	. . . . .	. . . . .	. . . . .	150	26.9	145	26.2	169	29.0
	Good, 1.86–2.20	. . . . .	. . . . .	. . . . .	. . . . .	186	33.4	163	29.1	120	20.6
	Passable, 2.21–3.00	. . . . .	. . . . .	. . . . .	. . . . .	110	19.7	30	5.3	30	5.1
	Poor, 3.01–6.00	. . . . .	. . . . .	. . . . .	. . . . .	6	1.0	2	0.3	3	0.5
						556		560		582	

In 1892 the average school-mark was 2.05, and 42 schools were rated above the average and 13 below. The average mark was 1.65 in 1893, when 27 schools were rated above and 28 below the average, all 55 schools being above the average of 1892. In 1894 the average school-mark was 1.60, which mark was exceeded in the case of 26 schools, and unattained by 29 schools. In 1894 31 schools were rated above the average for 1893 and 54 above the average for 1892; while 24 schools were rated below the average for 1893 and 1 below the average for 1892. These results warrant the conclusion there has been marked improvement in gymnastic instruction in the grammar schools during the last two years. The progress made in the primary schools, though less marked for obvious reasons, has been fairly satisfactory.

In closing this report I append as pertinent in this connection, the following extract from the report of Superintendent Philbrick made to the School Committee in 1872. Having noted the changes whereby the average physical condition of the pupils in the schools, during the previous twelve years, had been improved, Mr. Philbrick declares that he is "bound to say, and to say with emphasis, that there is still great room for improvement in physical culture. *We ought to aim, not merely* TO AVOID INJURING *the health of pupils while carrying on their instruction in our schools, but* TO INCREASE *their physical health, strength, and beauty.* . . . You may say that the exigencies of modern society demand some sacrifice of physical health and strength to intellectual attainments. For one I deny the soundness of this doctrine altogether. Complete physical health and development is essential to the truest and best intellectual results of education. . . . All we have done in the interest of school hygiene during the past twelve years is far, very far, from being what we can safely accept as a satisfactory finality. It is, in truth,

only a *beginning* of the vast work yet to be accomplished, if we mean to make our system of education a complete success."

All of which is respectfully submitted,

EDWARD MUSSEY HARTWELL,
Director of Physical Training.

JUNE, 1894.